North Carolina Department of Natural and Cultural Resources

State Historic Preservation Office

Ramona M. Bartos, Administrator

Governor Pat McCrory
Secretary Susan Kluttz

Office of Archives and History
Deputy Secretary Kevin Cherry

January 26, 2016

Jami P. Lanier
Cape Hatteras National Seashore
1401 National Park Drive
Manteo, NC 27954

jami.p.lanier@nps.gov

Re: Cape Hatteras Lighthouse Historic Structure Report, Dare County, ER 16-0045

Dear Ms. Lanier:

Thank you for your letter of December 31, 2015, regarding the above-referenced report. We have reviewed the 100% draft of the Cape Hatteras Historic Structure Report and offer the following comments.

The Historic Structure Report for the National Register-listed Cape Hatteras Light Station (DR0004) is well researched and effectively addresses current and future conservation, repair and maintenance issues associated with the property. The report will be a useful reference for the interpretation of this resource, its history, and the surrounding landscape.

We are pleased an emphasis on conservation treatments for repairs and maintenance of the light station, e.g. recent shifts towards the use of vapor-permeable coatings for historic masonry were included in the report. Employing best preservation practices will provide a more effective long-term protection of the property and its character-defining features. While recommended treatments outlined in the report appear to offer the best practices at this time, future treatments should include research into improvements, which may result in adapting conservation practices.

We anticipate the recommended treatments addressed in the report for the preservation of the lighthouse will have a minimal effect to the property's historic fabric. For investigation and repair of stair components, we recommend using caution in disassembling historic cast-iron elements. Previous repairs have resulted in breakage and complete loss of materials. While some damage is unavoidable, great care should be taken in dismantling the historic stairs. We also recommend the historic mortar be analyzed prior to repairing or repointing of the masonry to ensure new mortar matches existing mortar in strength and texture.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579 or environmental.review@ncdcr.gov. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

for Ramona M. Bartos

United States Department of the Interior

NATIONAL PARK SERVICE

Fort Raleigh National Historic Site Wright Brothers National Memorial

Cape Hatteras National Seashore
1401 National Park Drive
Manteo, NC 27954
252-473-2111

HISTORIC PRESERVATION OFFICE

IN REPLY REFER TO:

H2215 (CAHA-RM)

EZ 16- 0045

December 31, 2015

S-SECTION
POK 11/21/16

Memorandum

To: Renee Gledhill-Earley, Environmental Review Coordinator, State Historic Preservation Office

From: Jami P. Lanier, Cultural Resource Manager, NPS Outer Banks Group Dec 2/1/16

Subject: Review of Cape Hatteras Lighthouse Historic Structure Report

The park would like to request your review of the 100% Draft Cape Hatteras Lighthouse Historic Structure Report. The report, researched and written by the Historic Preservation Training Center (HPTC) architect Rebecca Cybularz, includes the developmental history of the Cape Hatteras Lighthouse and recommendations for treatment and use. The report specifically focuses on information necessary for understanding and preserving the lighthouse's existing and original features, character, and condition during the period of significance.

Upon completion, this planning document will serve as a valuable reference for park management and an important guideline for future rehabilitation of this National Historic Landmark.

TAKE PRIDE IN AMERICA

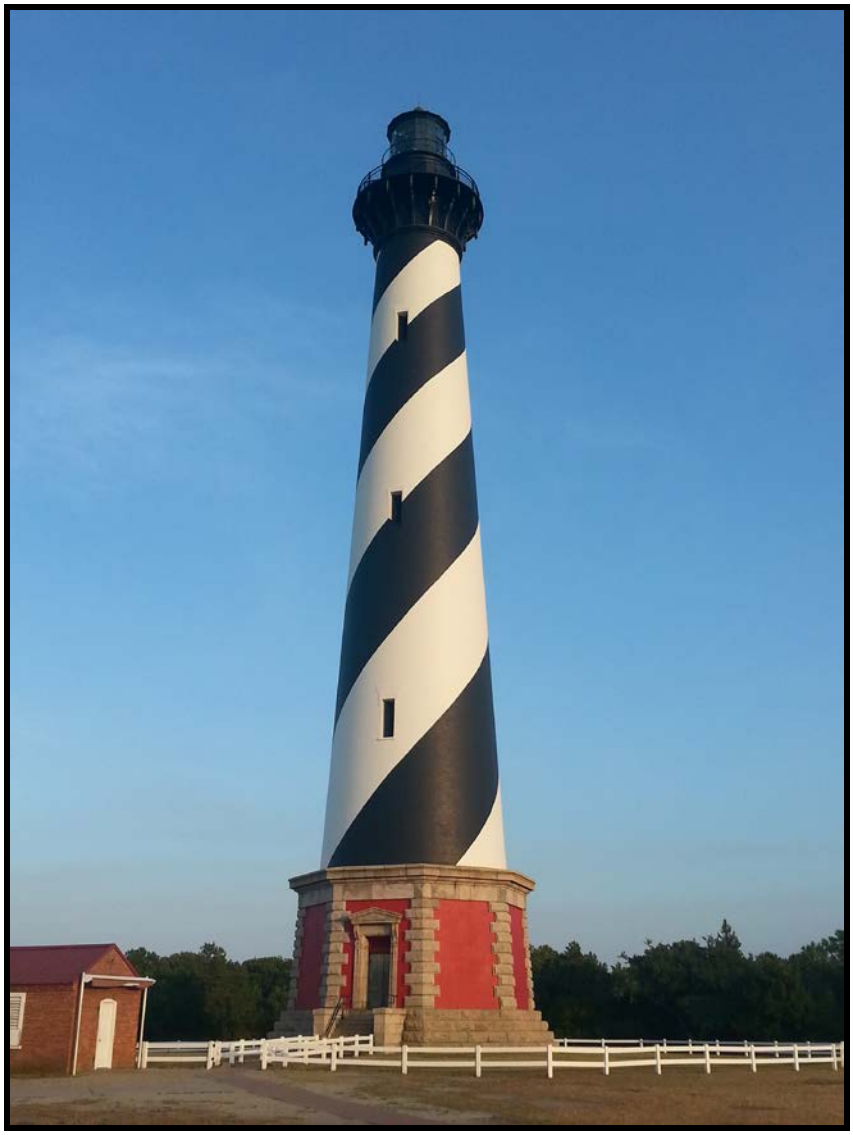
National Park Service
Department of the Interior

Cape Hatteras National Seashore
Manteo, NC

Cape Hatteras Lighthouse

Historic Structure Report

100% DRAFT



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

100% DRAFT

December 2015

for

Cape Hatteras National Seashore
Manteo, NC

by

Rebecca Cybularz
Historical Architect

Historic Preservation Training Center
Office of Learning and Development
Directorate of Workforce and Inclusion (WASO)
National Park Service
Frederick, MD

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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

Project Architect

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Historic Preservation Training Center (HPTC)
National Park Service

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Program Manager

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Rebecca Cybularz, Staff Historical Architect, HPTC
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Historic American Building Survey
National Park Service

Program Review

Ali Miri, Senior Historical Architect, SERO
Jami Lanier, Cultural Resources Manager, CAHA

Crack Monitoring Methodology

Kent Diebolt
Vertical Access

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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 and granite fence surrounding the base of the lighthouse (ca. 1920) 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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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.

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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 lighthouse's 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]

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]

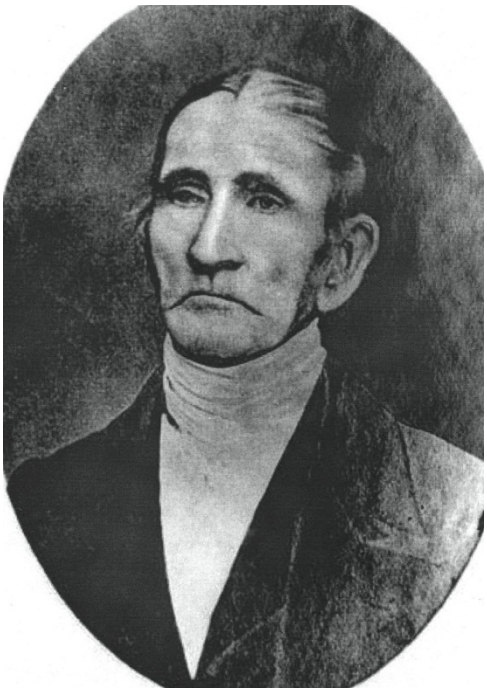


Figure 4. A portrait of Stephen Pleasonton.[12]

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]

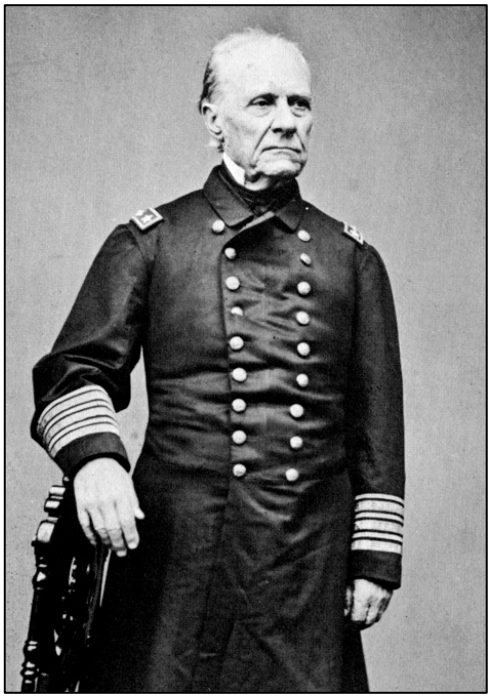


Figure 5. Commodore William B. Shubrick in a photograph taken during the Civil War, which was after his leadership with the USLHB. Photo: Library of Congress, LC-DIG-cwpb-05306.

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]

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]

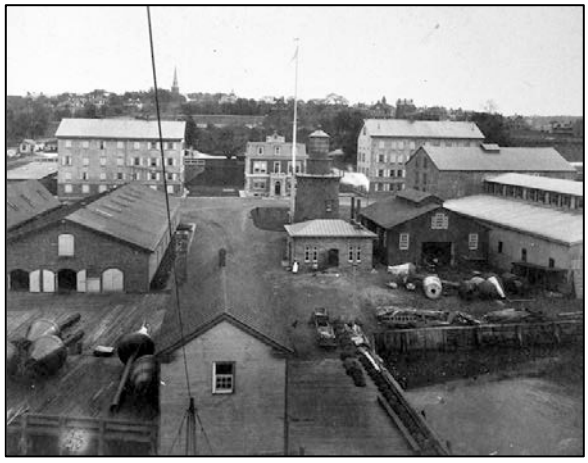


Figure 6. The General Lighthouse Depot located at Staten Island, NY, in ca. 1885. Photo: National Archives.[30]

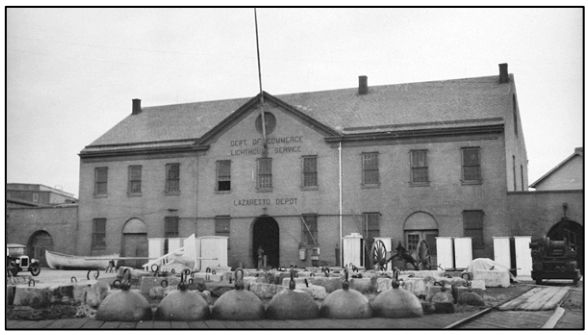


Figure 7. The Fifth District Lighthouse Depot located at Lazaretto Point in Baltimore, MD. Date unknown. Photo: Source unknown.[31]

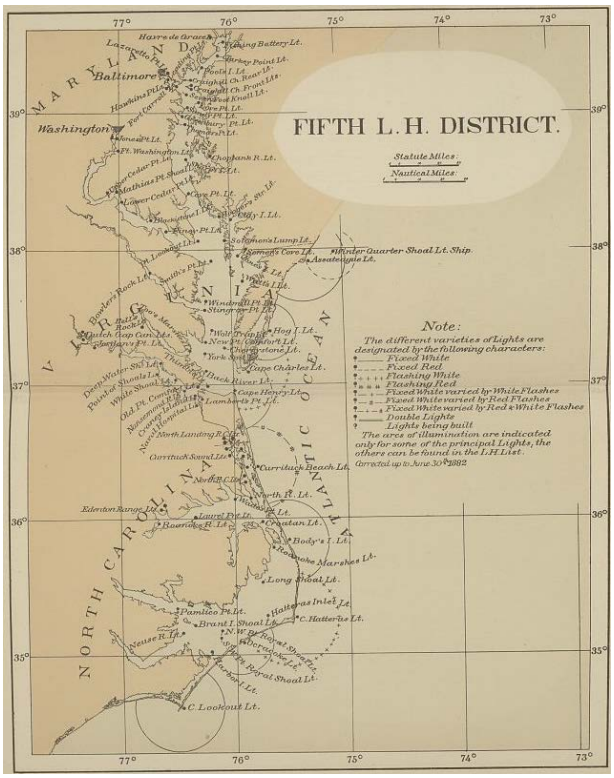
An inspector—an Army or Navy officer—was placed in charge of each district and had the responsibility of building lighthouse; keeping the lighthouses in repair; and purchasing, installation, and repairing the illuminating apparatuses. Within a few years, the board realized that the inspectors needed 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]


FIFTH L.H. DISTRICT.
Statute Miles
Nautical Miles
Note:
The different varieties of Lights are designated by the following characters:
Fixed White
Fixed Red
Flashing White
Flashing Red
Fixed White varied by White Flashes
Fixed White varied by Red Flashes
Fixed White varied by Red & White Flashes
Double Lights
Lights being built
The area of illumination are indicated only for some of the principal Lights, the others can be found in the L.H.List.
Corrected up to June 30th 1882
Baltimore
Washington
MARYLAND
VIRGINIA
NORTH CAROLINA
Cape Charles Lt.
Cape Henry Lt.
Currituck Beach Lt.
Bodie's I. Lt.
Long Shoal Lt.
Hatteras Inlet Lt.
C. Hatteras Lt.
Pamlico Pt. Lt.
Brant I. Shoal Lt.
Neuse R. Lt.
Bald Head Shoal Lt.
C. Lookout Lt.
Edenton Range Lt.
Laurel Pt. Lt.
Roanoke R. Lt.
Croatan Lt.
Roanoke Marshes Lt.
Hog I. Lt.
Wolf Trap Lt.
Windmill Pt. Lt.
Stingray Pt. Lt.
Lambert's Pt. Lt.
Deep Water Sh. Lt.
Pointer Shoals Lt.
Old Pt. Comfort Lt.
Newport News Lt.
Cape Charles Lt.
Cherrystone Lt.
Smith Landing R. Lt.
Hooper's Cove Lt.
Stingray Pt. Lt.
Mathias Pt. Shoal Lt.
Upper Cedar Pt. Lt.
Lower Cedar Pt. Lt.
Cove Pt. Lt.
Greenbury Pt. Lt.
Ft. Washington Lt.
Kinsale Pt. Lt.
Hawkins Pt. Lt.
Lazaretto Pt. Lt.
Havre de Grace
Rock Pt. Lt.
Dutch Gap Cut Lt.
Bermuda Pt. Lt.
Point of Rocks Lt.
Wade Shoal Lt.
Hooper's Cove Lt.
Stingray Pt. Lt.
Windmill Pt. Lt.
Wolf Trap Lt.
Hog I. Lt.
Cherrystone Lt.

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 two 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 stay 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.

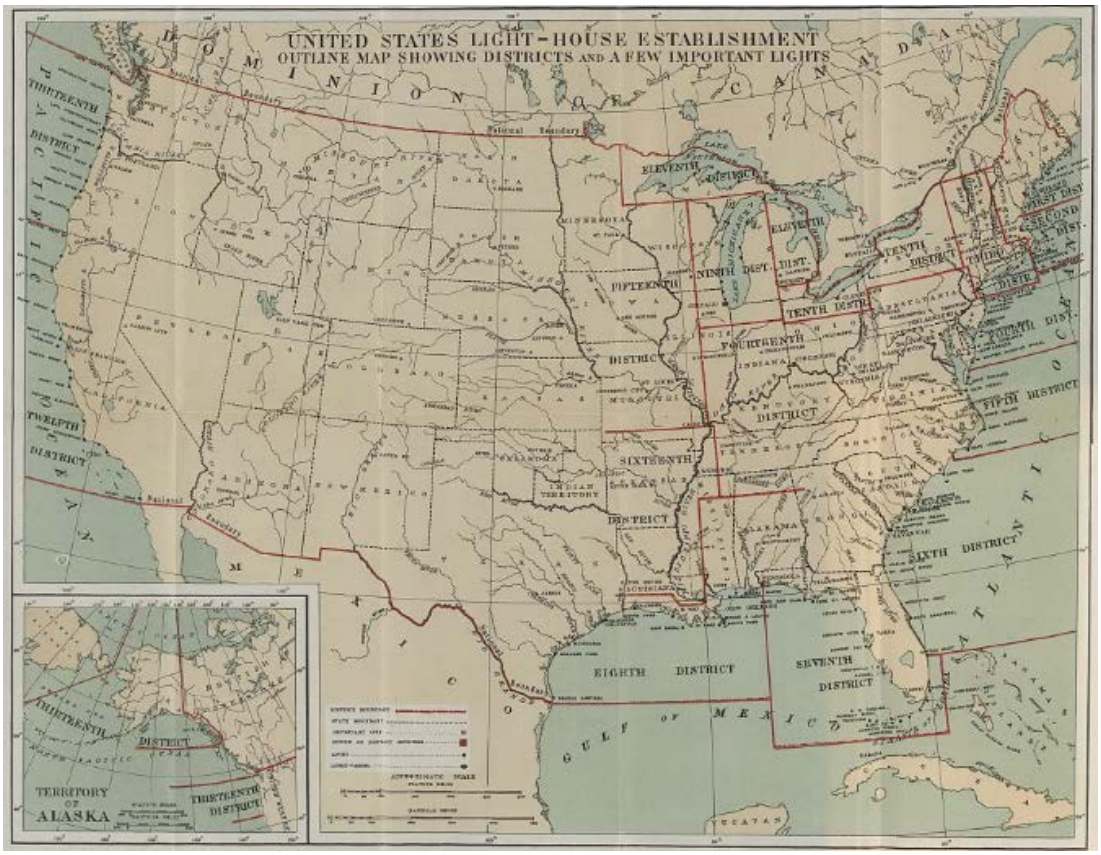

Figure 9, An 1896 map showing the division of the lighthouse districts at that time. Map: Library of Congress Catalog No. 2006678401.

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]

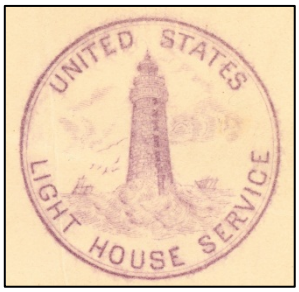

Figure 10. The seal of the USLHS. Photo: United States Coast Guard.[48]

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]

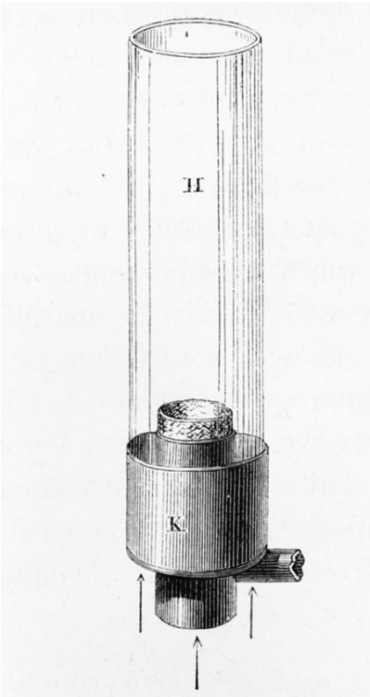

Figure 11. Argand's lamp included a hollow wick. Photo: Library of Congress, LC-USZ62-110395.

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.

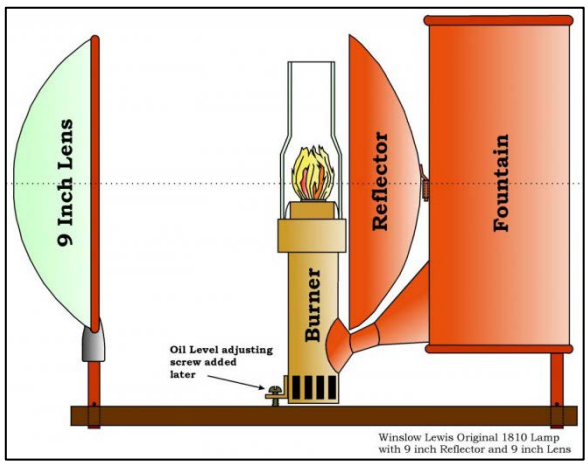

Figure 12. A diagram showing Winslow Lewis's parabolic reflector, Argand-style lamp, and glass lens. Source: U.S. Lighthouse Society.[59]

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]

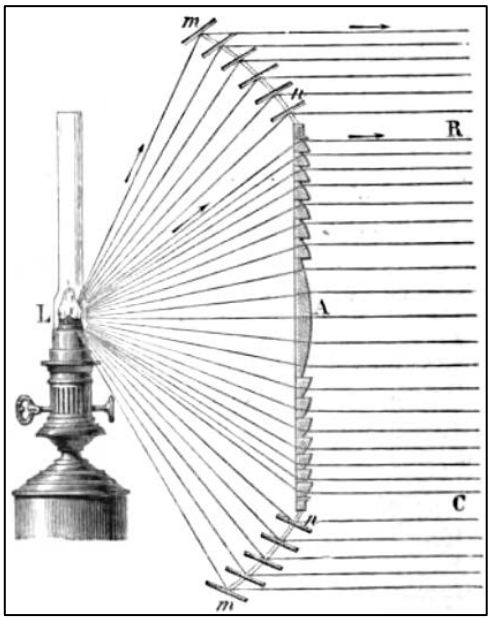

Figure 14. Fresnel placed a dioptric lens in front of a light source which refracted the light into beams.[63]

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]

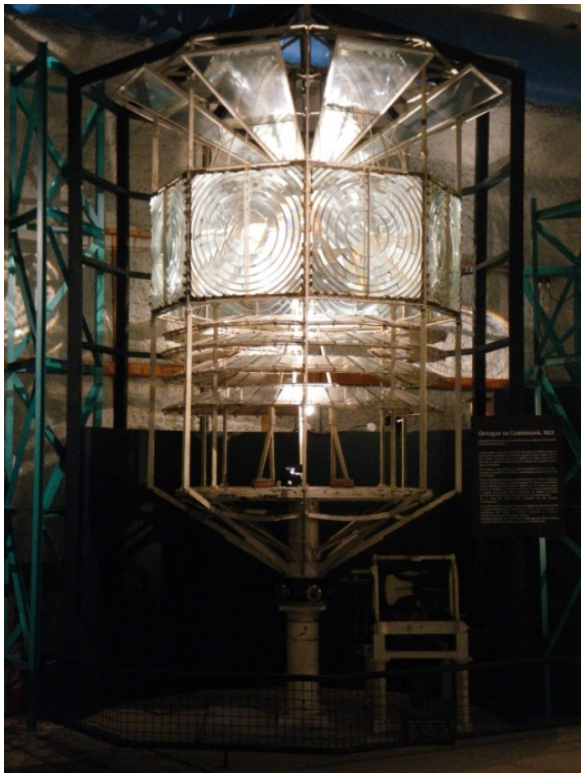

Figure 15. The first Fresnel lens used at Cordouan Lighthouse. Photo: *Musee des Phares et Balises de Ouessant, Phare du Creac'h.*[69]

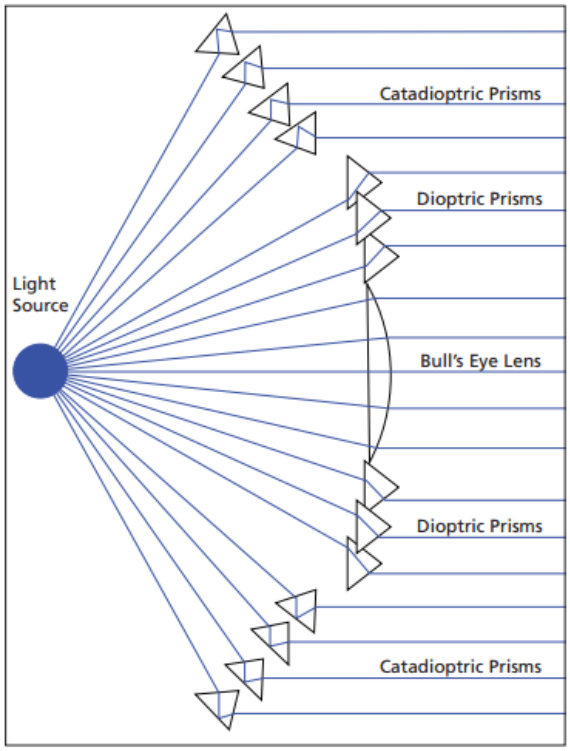

Figure 16. A rendering of how a Fresnel lens works. Fresnel developed the technology to bend light from the source into perfectly parallel beams through prisms. Dioptric prisms bent the light once. Catadioptic prisms bent the light twice. Drawing: NPS, "The Historic Point Reyes Lighthouse."[70]

[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]

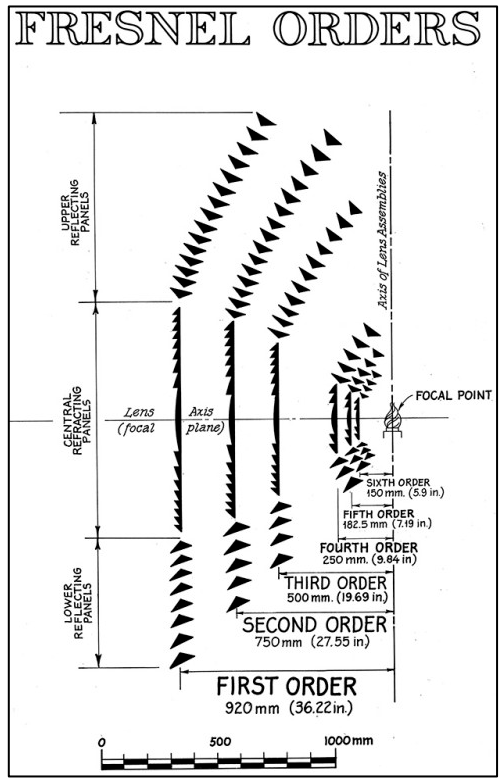

Figure 17. The six Fresnel lens sizes. The dioptric lens is labeled as the central refracting panels. The catoptric lenses are labeled as the upper and lower reflecting panels. Table: Spring Point Ledge Lighthouse.[71]

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

[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]

[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.

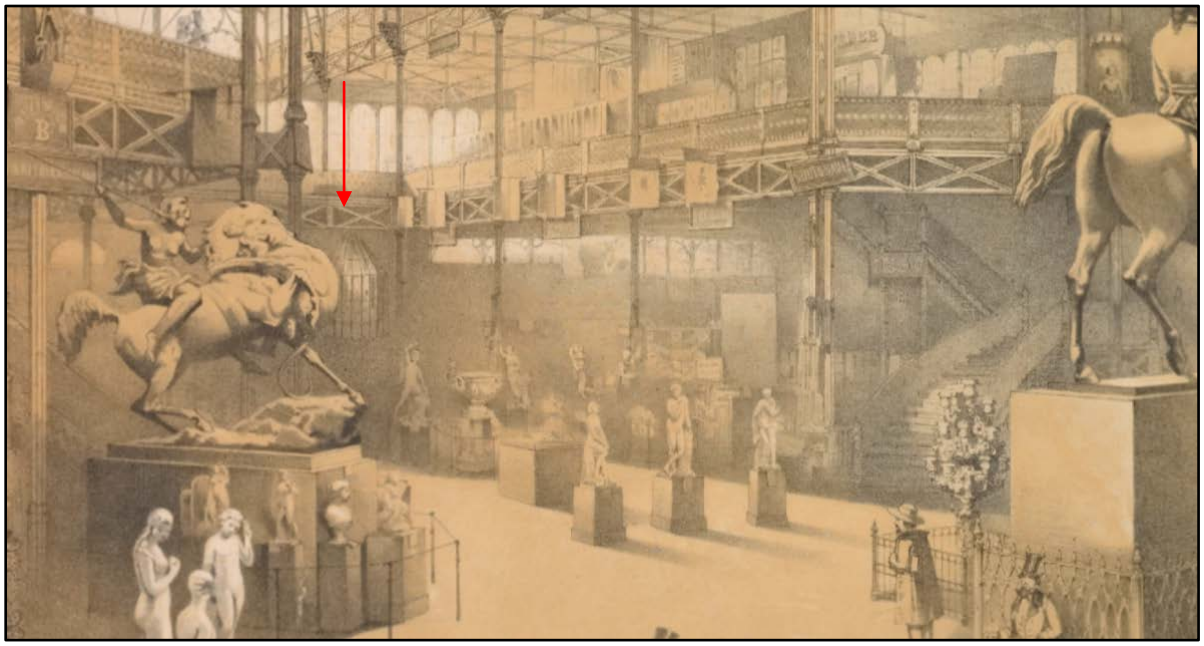

Figure 20. A rendering of the interior of the Crystal Palace in New York on December 1, 1853 shows the First-Order Fresnel Lens intended for the Cape Hatteras Lighthouse on display (arrow). Source: The New York Public Library Digital Collections.[18] Cropped by author.

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).

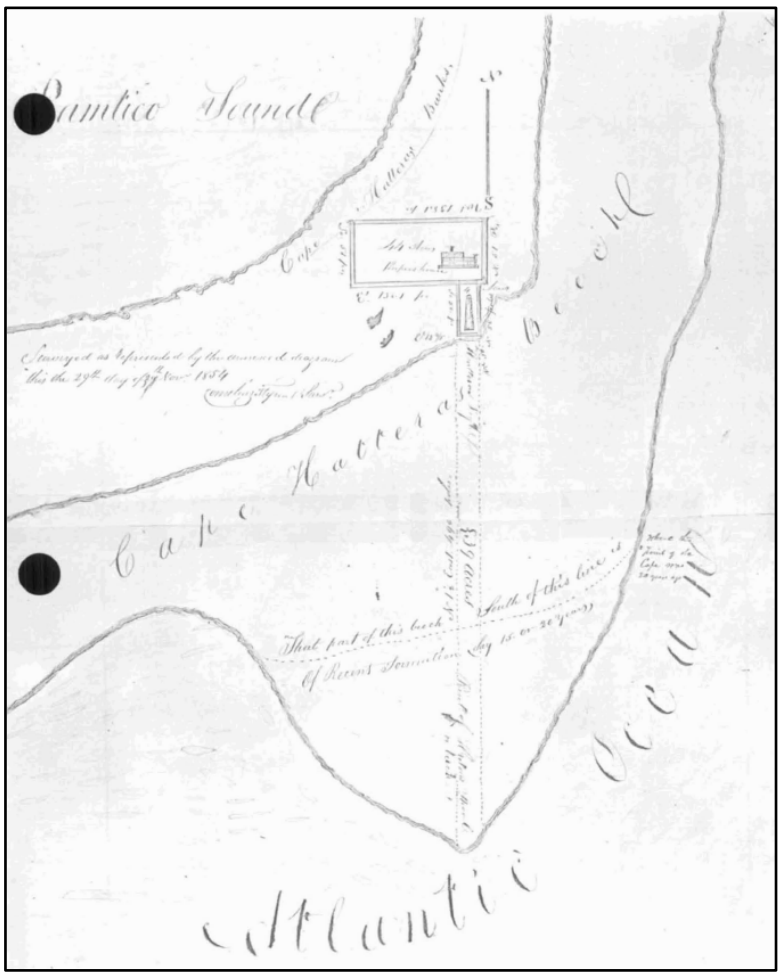

Figure 21. The layout of the Cape Hatteras Light Station in 1854. Source: Site File, Cape Hatteras Light Station, R.G. 26, National Archives. Copied from F. Ross Holland, Jr.'s 1968 Report, Appendix, Illustrations.

> 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."

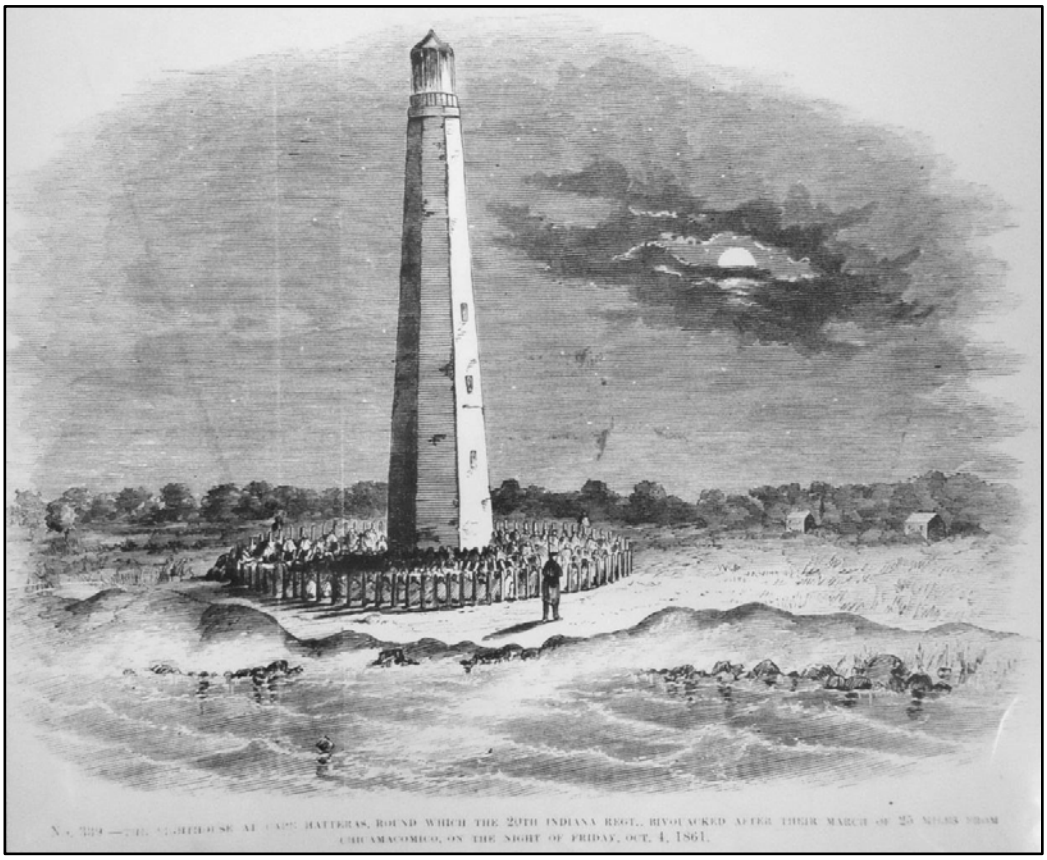

Figure 23. A rendering of the lighthouse during the Civil War shows the 20th Indiana Regiment camped on October 4, 1861. Source: Cape Hatteras National Seashore Archives.

[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 deigns 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 lighthouse 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 keepers 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 keepers' dwelling.

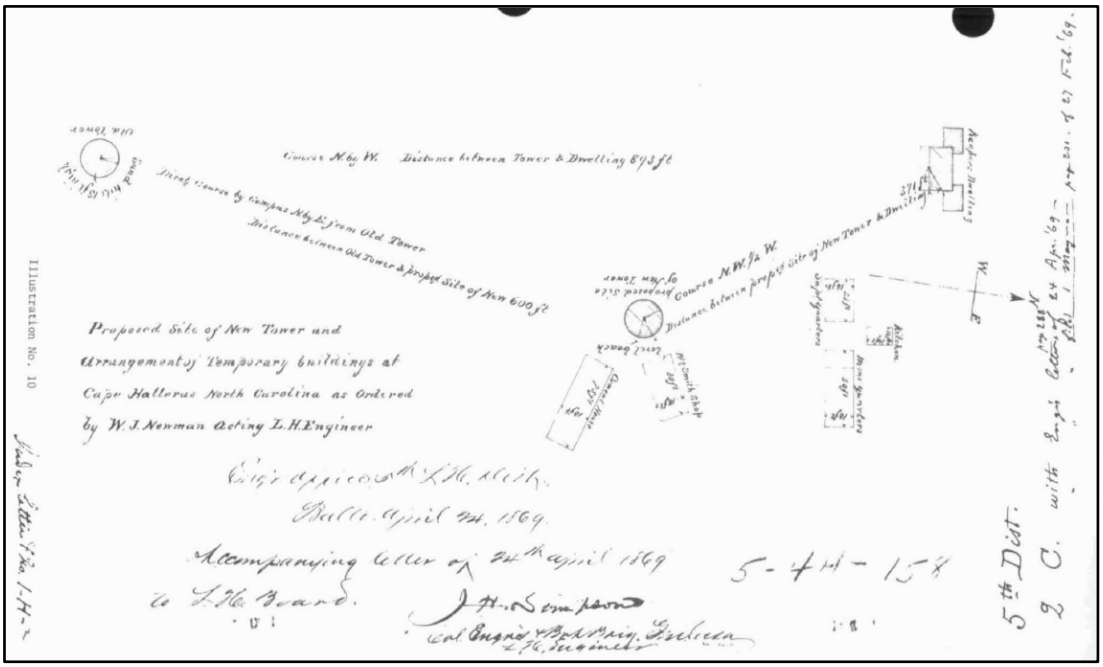

Figure 24. A drawing entitled "Proposed Site of New Tower and Arrangement of Temporary Buildings at Cape Hatteras North Carolina as Ordered by W.J. Newman, Acting L.H. Engineer." Dated April 24, 1869. Source: Engineering Files, 5th Coast Guard District Headquarters. Copied from Holland, Jr.'s "A History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

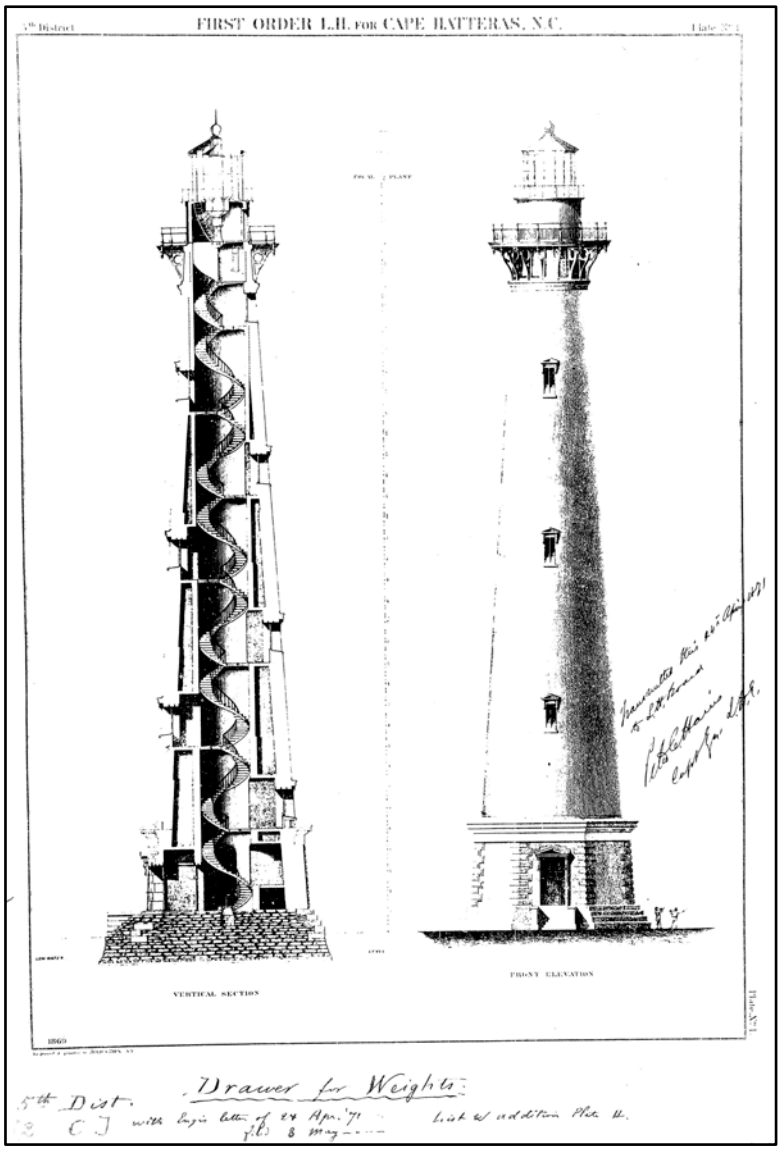

Figure 25. Plate No. 1 of the lighthouse construction drawings, published by the GPO in 1869. Drawing: NPS DSC eTIC No. CAHA 603 25007.

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

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]

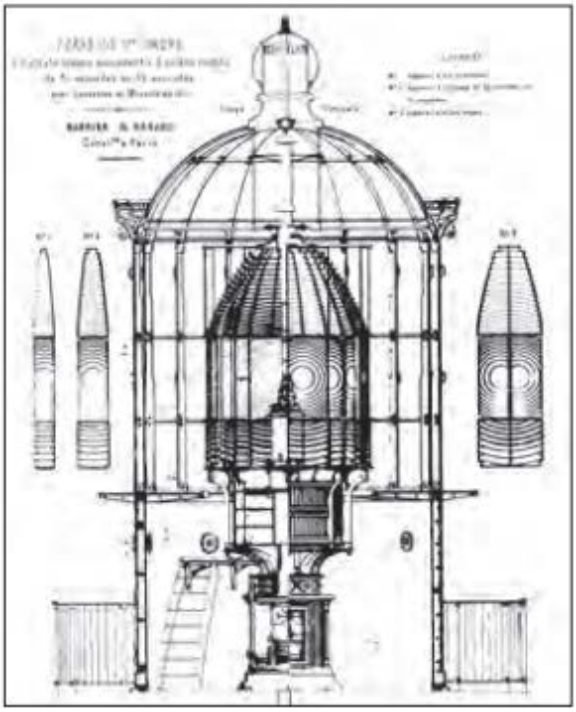

Figure 26. An original drawing of the Fresnel lens at Point Reyes Lighthouse, very similar to the original lens for Cape Hatteras Lighthouse. Drawing: NPS, "The Historic Point Reyes Lighthouse."[78]

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.

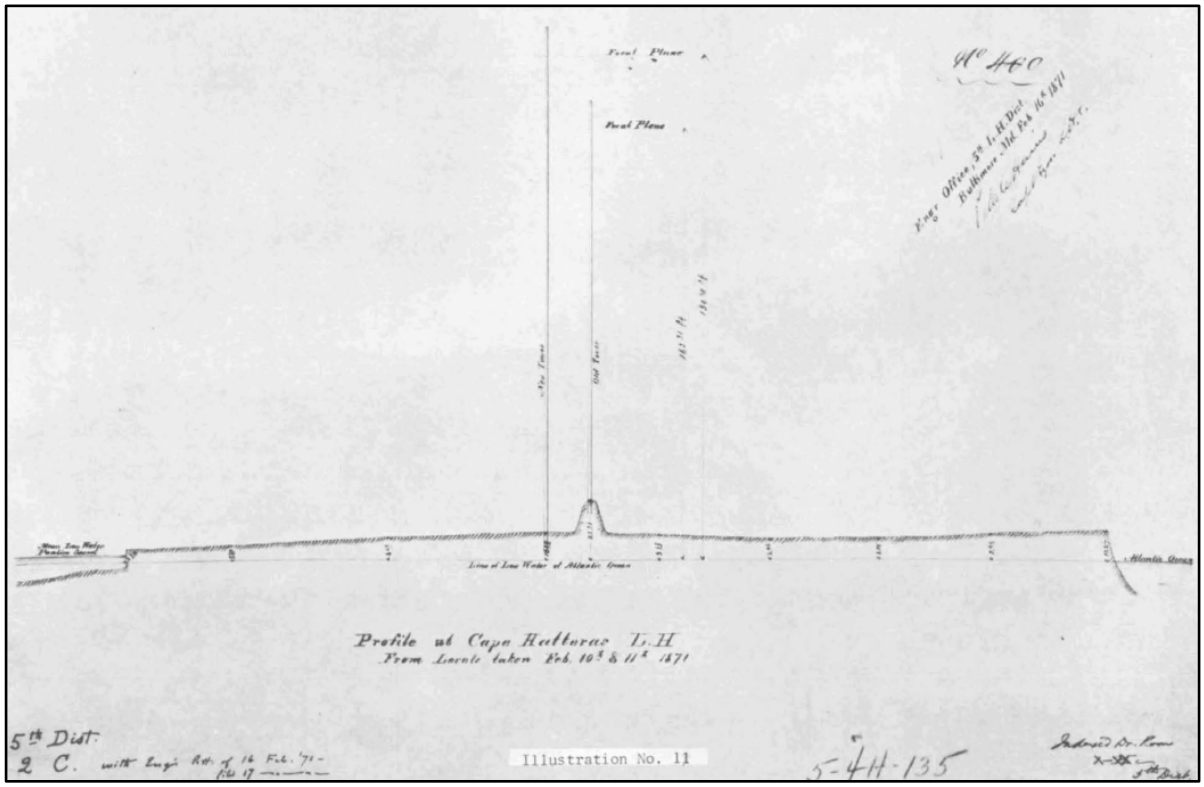

Figure 27. Drawing entitled "Profile at Cape Hatteras L.H." from February 10-11, 1871. The drawing shows the focal point of the old tower and the new tower. Source: Engineering Files, 5th Coast Guard District Headquarters. Copied from Holland, Jr.'s "A History of Cape Hatteras Light Station."

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]

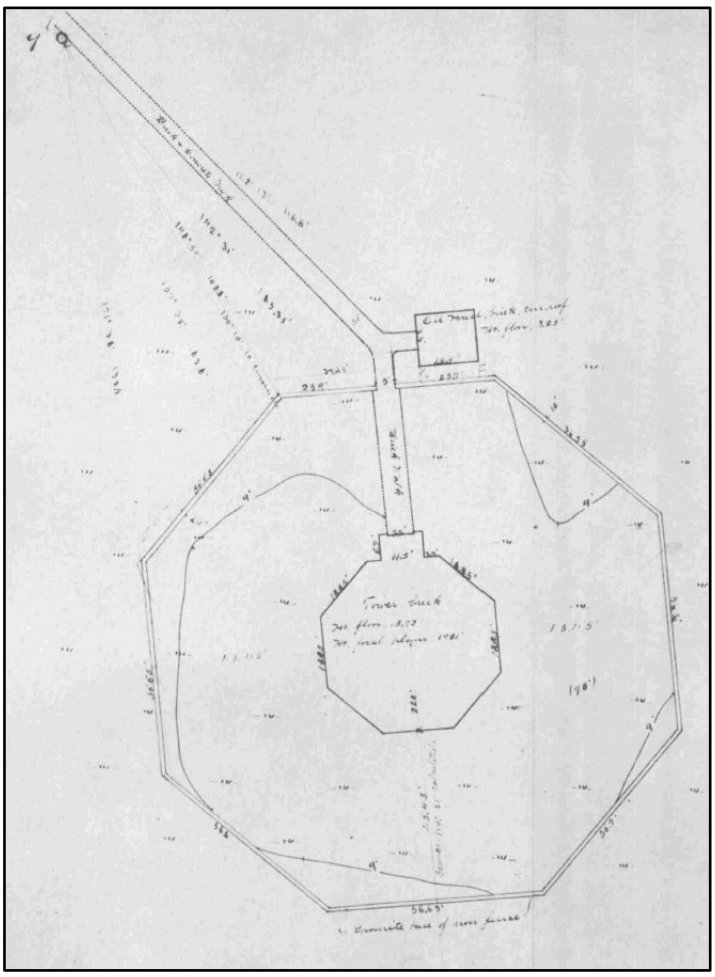

Figure 28. A site plan of the tower area with measurements, including those for the granite and iron fence surrounding the base of the lighthouse. Source: Site File, Cape Hatteras Light Station, RG 26, National Archives. Copied from Holland, Jr.'s "A History of Cape Hatteras Light Station."

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).

[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]

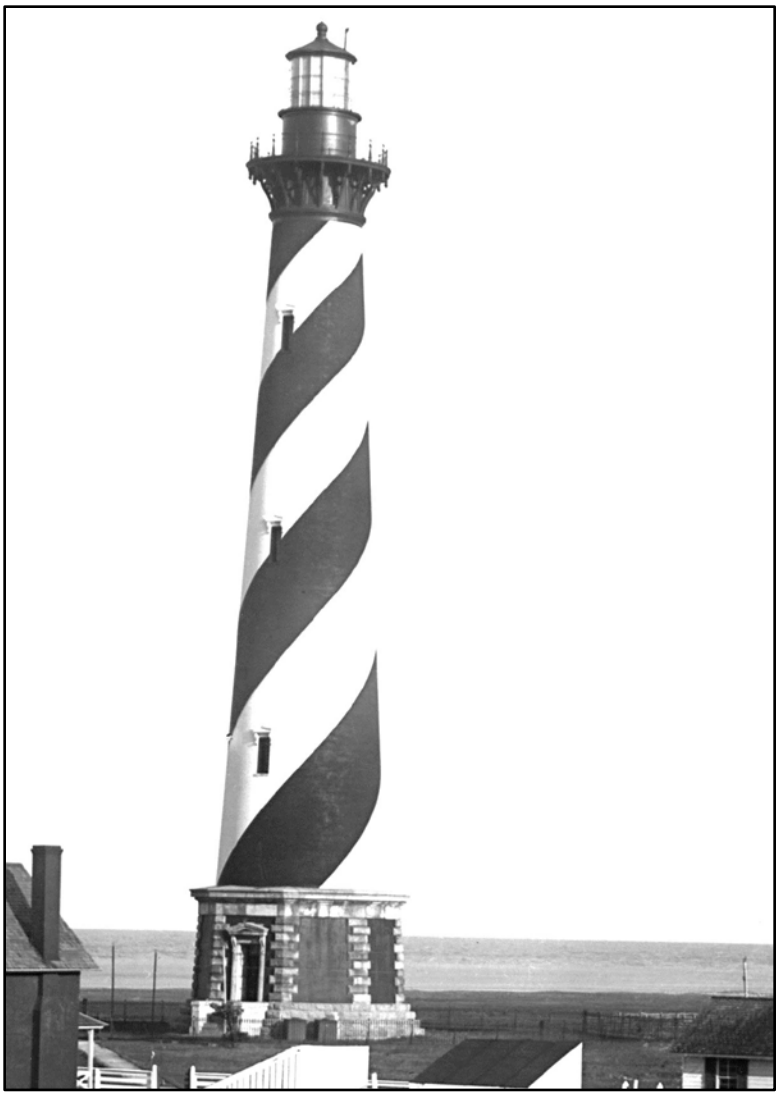

Figure 30. The lighthouse on May 30, 1893. Note the neat iron fence at the base, spiral-striped paint, window hoods over each window, and blinds on the interior of the lantern. Photo: National Archives and Records Administration RG 26, LG 26 82A. Copy found in NPS Harpers Ferry Center photographic archives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

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 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.)

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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.
[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.

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).

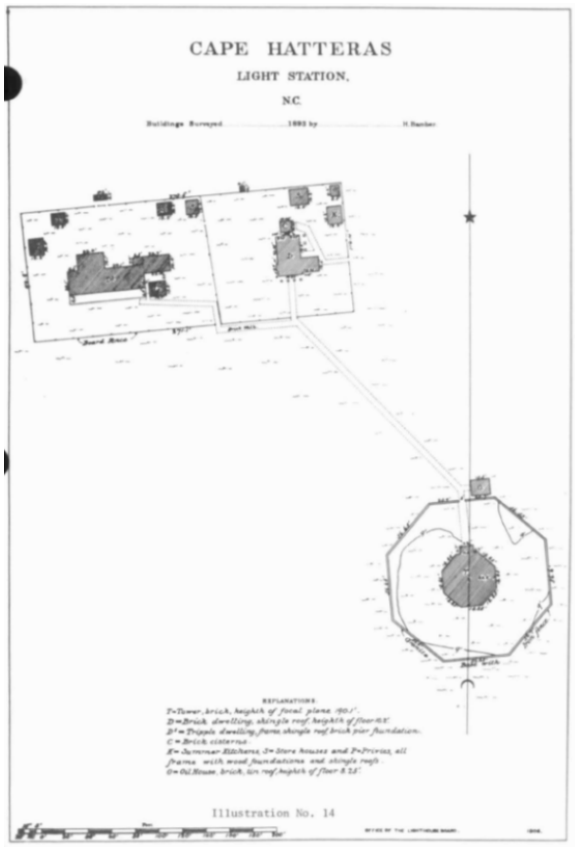

Figure 31. An 1893 site plan of the buildings at Cape Hatteras Light Station by Bamber (published by the USLHB in 1904. Source: Engineering Files, 5th Coast Guard District Headquarters. Copied from Holland, Jr.'s "A History of Cape Hatteras Light Station."

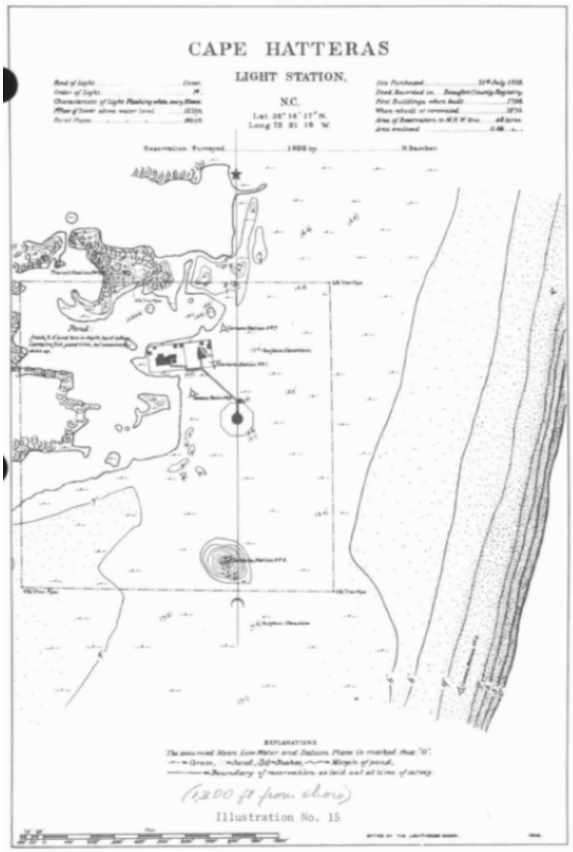

Figure 32. An 1893 site plan of the Cape Hatteras Light Station by Bamber (published by the USLHB in 1904. Source: Engineering Files, 5th Coast Guard District Headquarters. Copied from Holland, Jr.'s "A History of Cape Hatteras Light Station."

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 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]

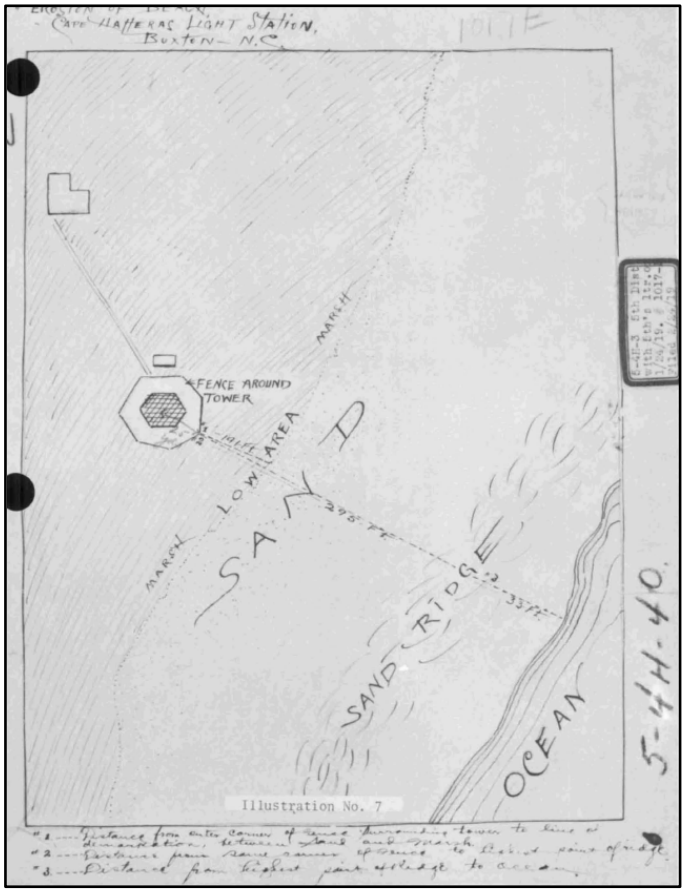

Figure 38. A drawing from ca. 1919 depicting the erosion at the light station. Source: Site File, Cape Hatteras Light Station, RG 26, National Archives. Copied from Holland, Jr.'s "A History of Cape Hatteras Light Station."

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]

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 keepers' 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. It was completed on September 18, 1935 (fig. 41).[154]

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 camps were assigned to the "Outer Banks to protect the shore and revitalize the natural vegetation of the

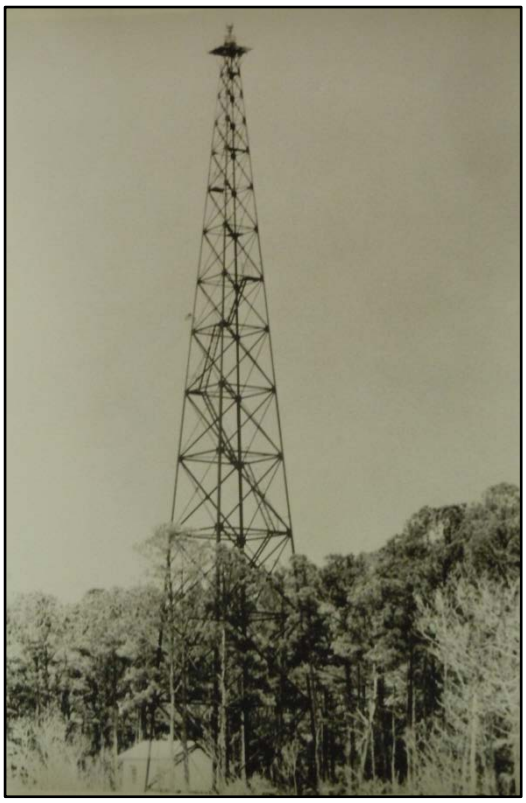

Figure 41. The new skeleton tower as seen on June 22, 1936. Photo: Cape Hatteras National Seashore Archives.

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

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 of a picturesque and fast-disappearing type no longer constructed." Moreover, the light fit in

[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

> 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]

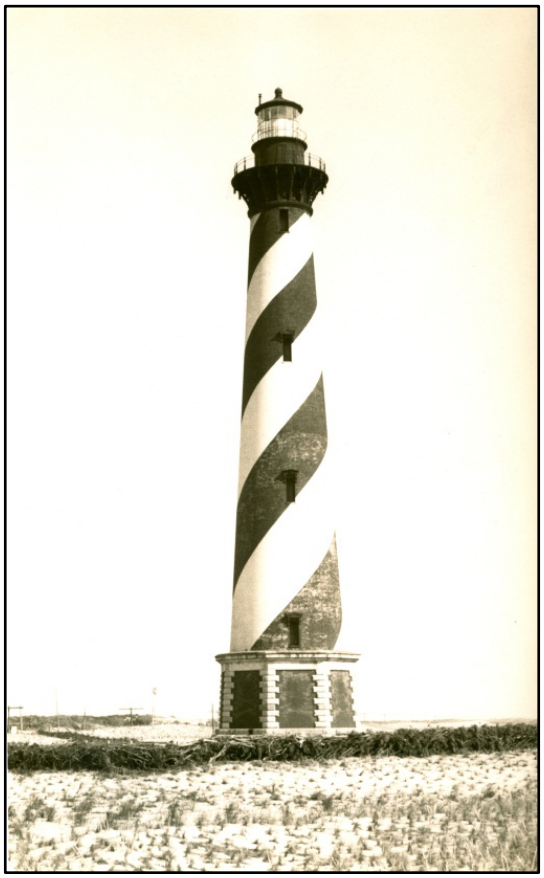

Figure 44. The south elevation of the lighthouse in March 1937. Photo: Cape Hatteras National Seashore Archives.

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.

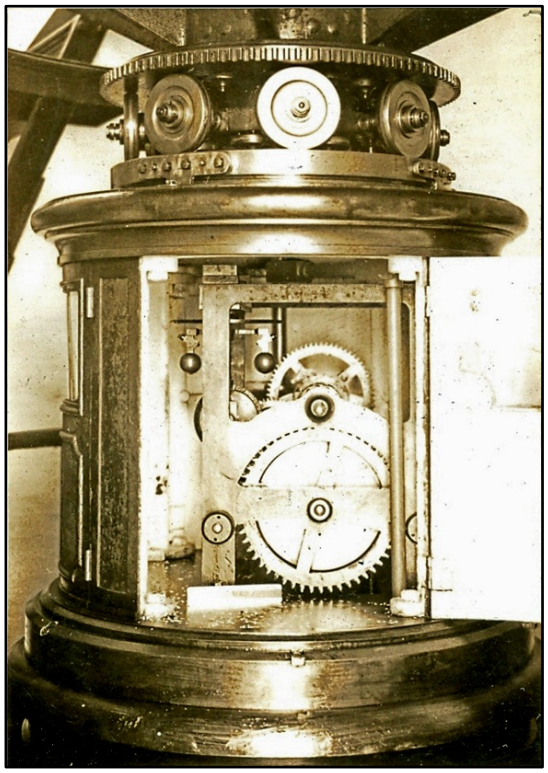

Figure 48. The interior of the clockworks with rotating chariot wheel above. Photo: Cape Hatteras National Seashore Archives.

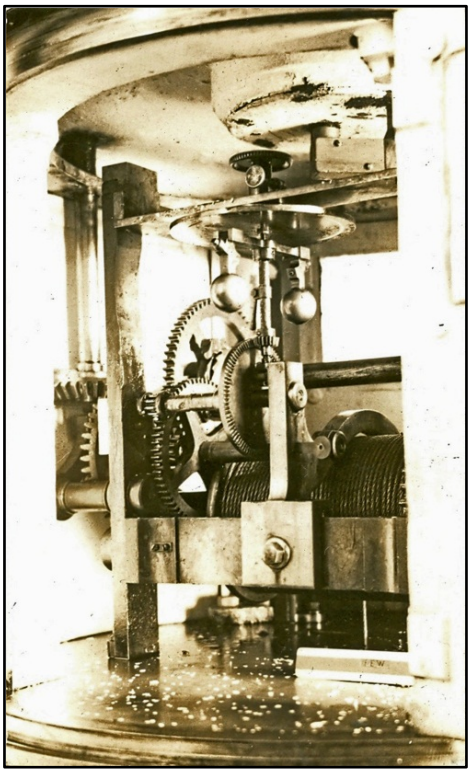

Figure 49. The interior of the clockworks at the gallery level. Photo: Cape Hatteras National Seashore Archives.

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]

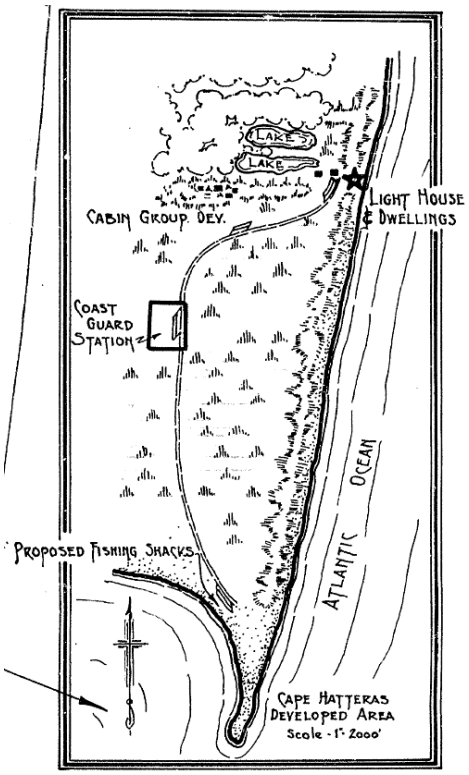

Figure 50. January 1939 GMP site plan showing the layout of the Cape Hatteras Developed Area. Drawing: NPS DSC eTIC No. CAHA 603 2060. Cropped by author.

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]

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).

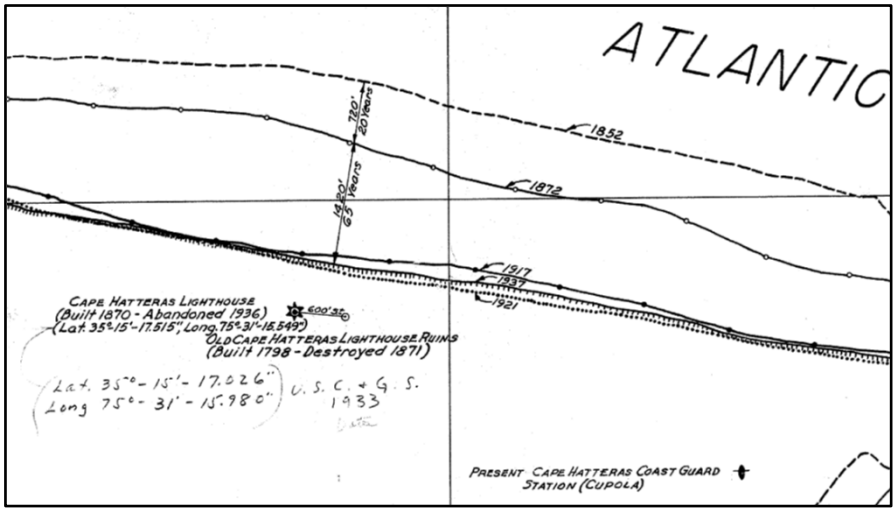

Figure 51. A 1939 site plan showing the invasion of the shoreline toward the lighthouse. Drawing: NPS DSC eTIC No. CAHA 603 5300 Z1. Cropped by author.

[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]

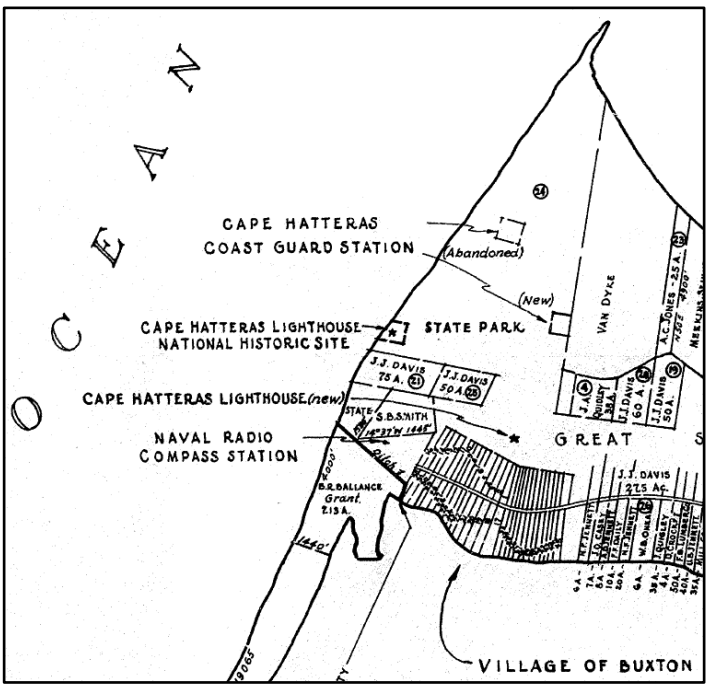

Figure 52. A December 1941 site plan of the Cape Hatteras Lighthouse National Historic Site, the State Park surrounding it, and other area landowners. Drawing: NPS DSC eTIC No. CAHA 603 2018. Cropped by author.

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 creaking 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.

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[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]

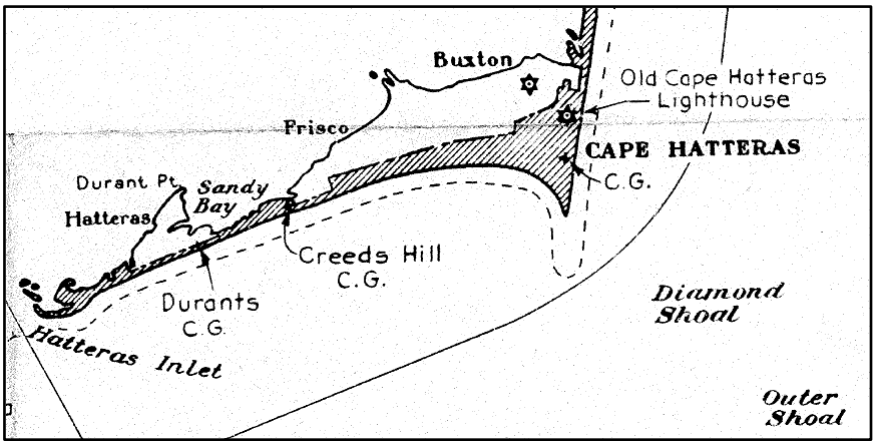

Figure 56. The late-1952 site plan showing a portion of the boundary of the new park. Drawing: NPS DSC eTIC No. CAHA 603 7017B. Cropped by author.

During the month of August 1954, the NPS…

[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 lone 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]

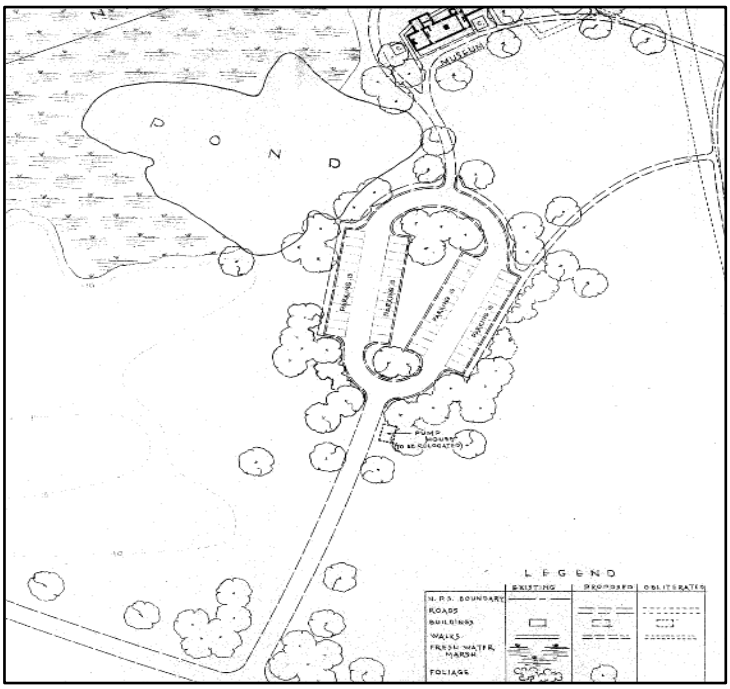

Figure 57. The 1955 site plan depicting the light station. Drawing: NPS DSC eTIC No. CAHA 603 3025. Cropped by author.

[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."

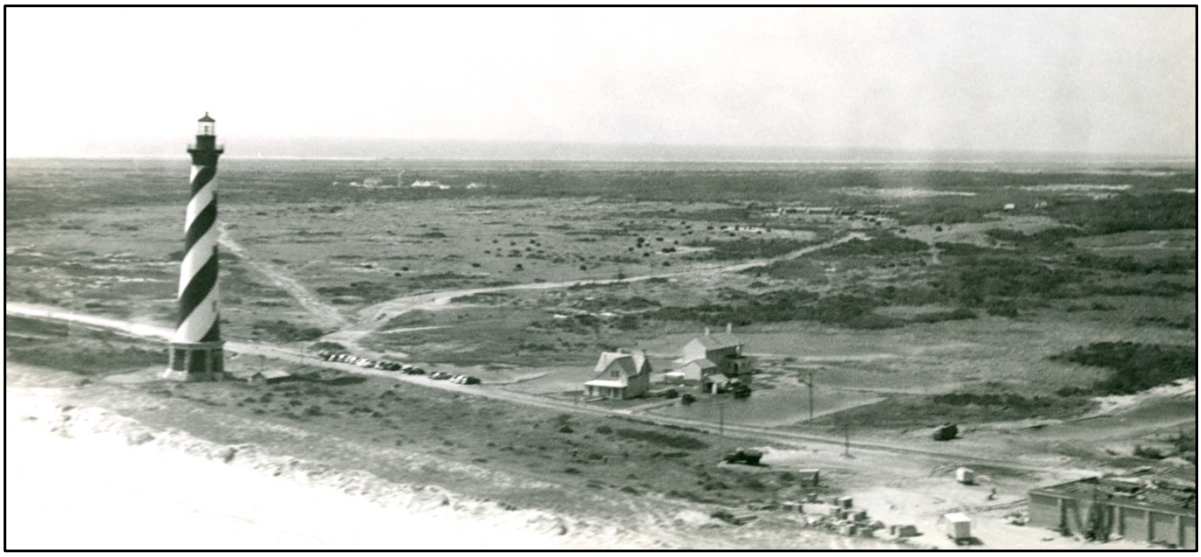

Figure 58. The light station in 1955. Note the fence around the base of the lighthouse has been removed and the presence of cars due to construction of the major road to Hatteras Island. Photo: Cape Hatteras National Seashore Archives.

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]

[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).

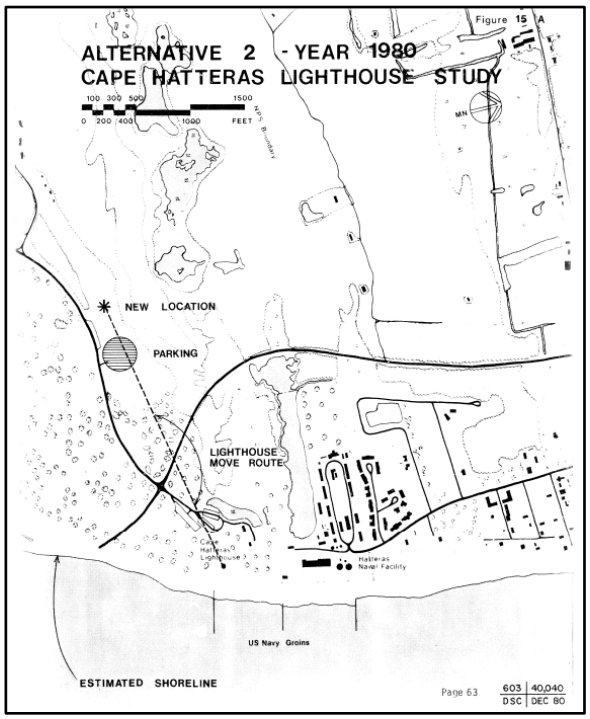

Figure 62. Alternative 2 (moving the lighthouse) in 1980. Drawing: NPS DSC eTIC No. CAHA 603 40040.

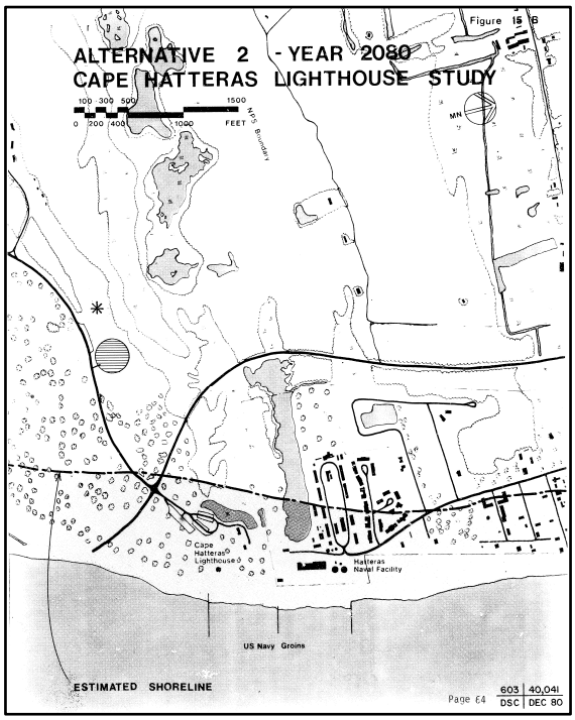

Figure 63. Alternative 2 projected to 2080. Drawing: NPS DSC eTIC No. CAHA 603 40041.

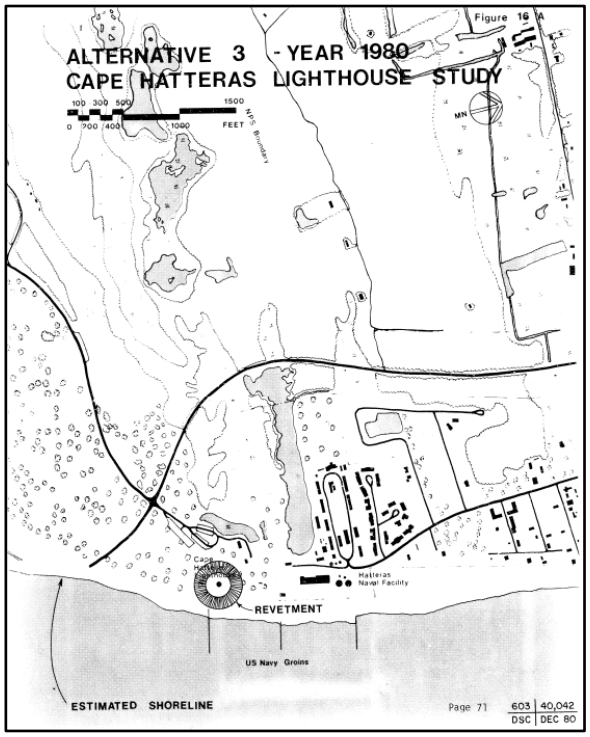

Figure 64. Alternative 3 (revetment) in 1980. Drawing: NPS DSC eTIC No. CAHA 603 40042.

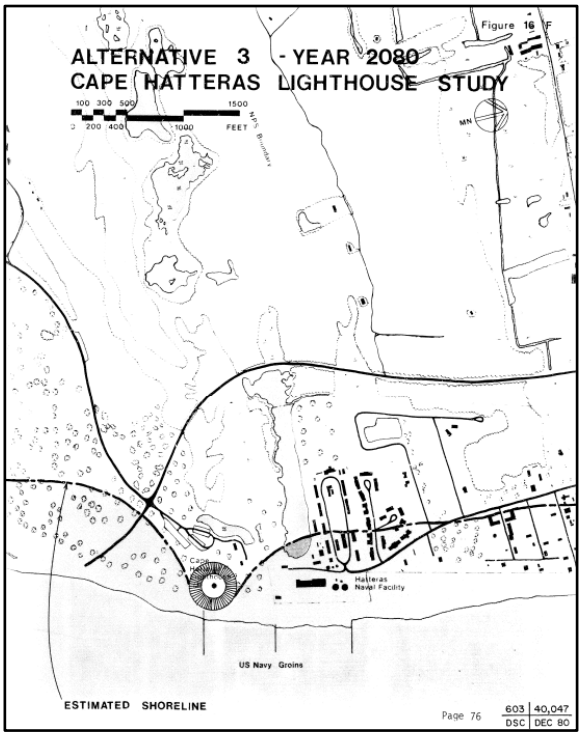

Figure 65. Alternative 3 projected to 2080. Drawing: NPS DSC eTIC No. CAHA 603 40047.

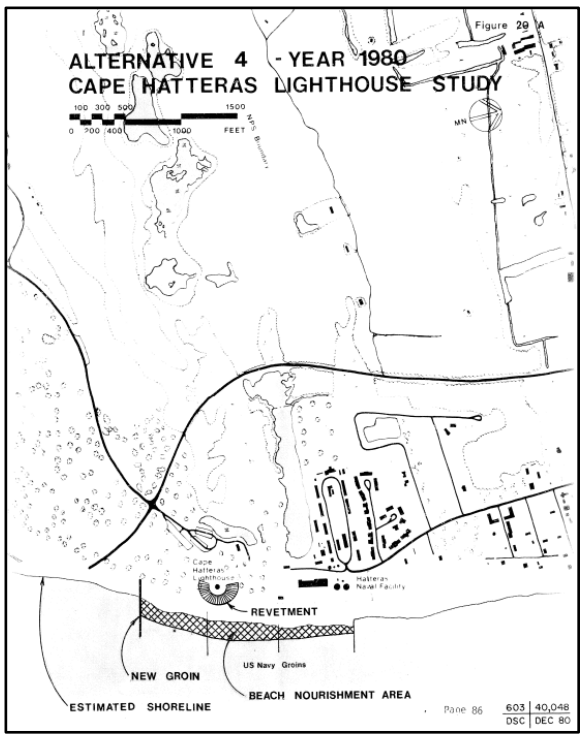

Figure 66. Alternative 4 (partial revetment, new groins, beach nourishment) in 1980. Drawing: NPS DSC eTIC No. CAHA 603 40048.

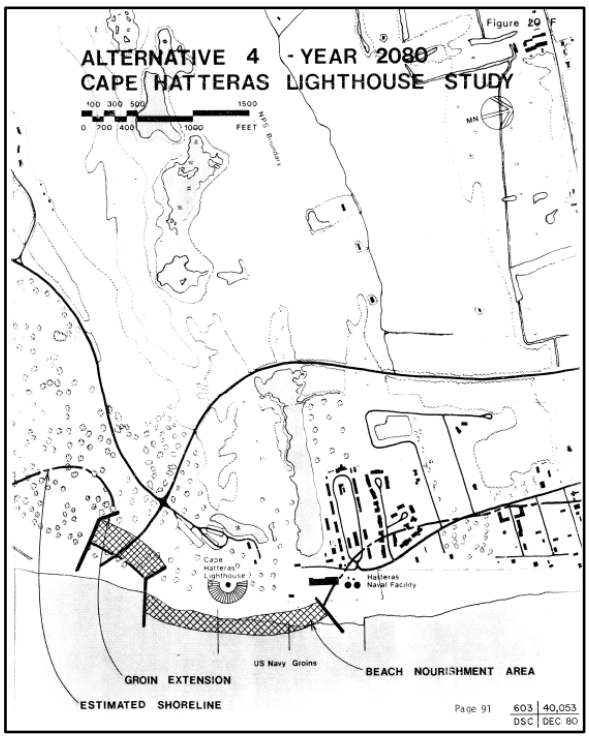

Figure 67. Alternative 4 projected to 2080. Drawing: NPS DSC eTIC No. CAHA 603 40053.

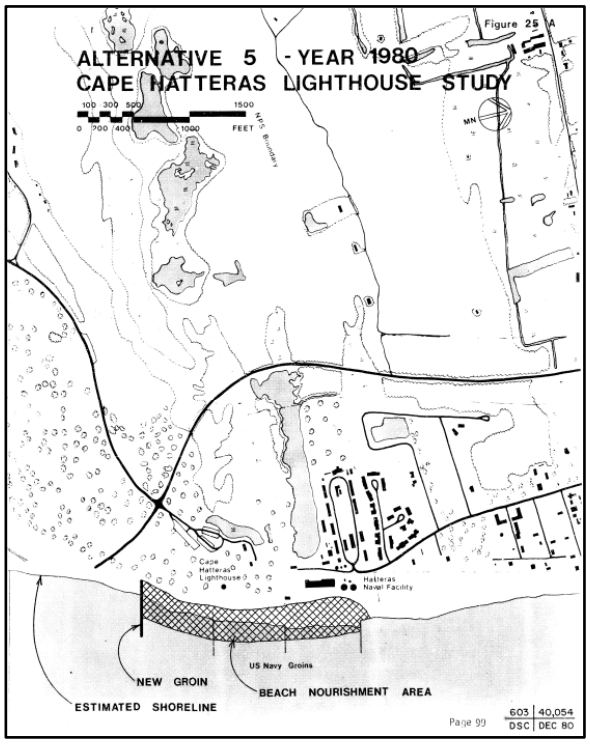

Figure 68. Alternative 5 (new groins, beach nourishment) in 1980. Drawing: NPS DSC eTIC No. CAHA 603 40054.

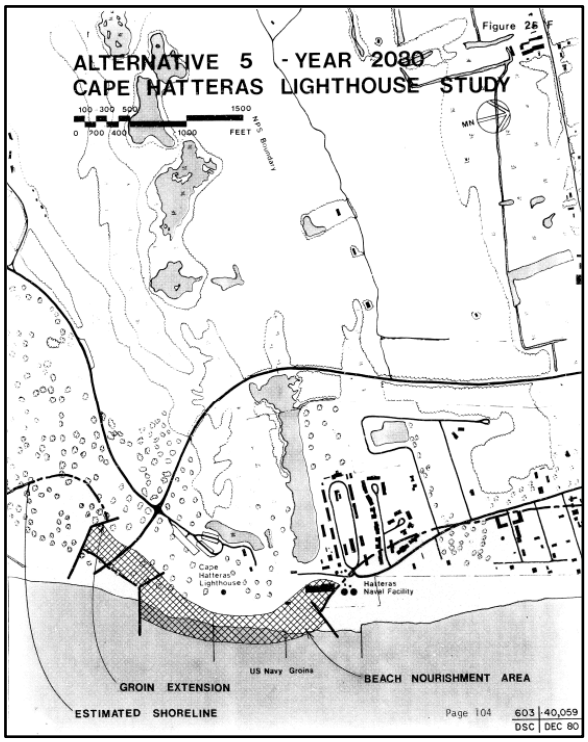

Figure 69. Alternative 5 projected to 2080. Drawing: NPS DSC eTIC No. CAHA 603 40059.

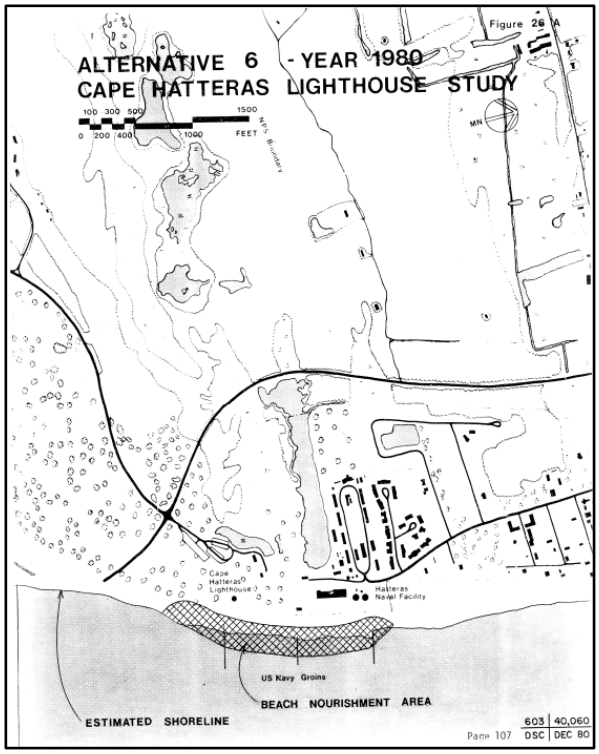

Figure 70. Alternative 6 (beach nourishment) in 1980. Drawing: NPS DSC eTIC No. CAHA 603 40060.

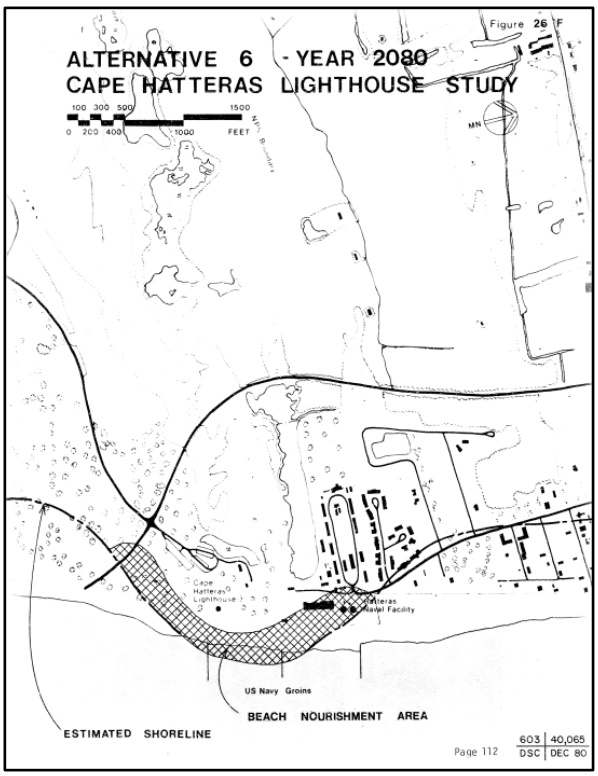

Figure 71. Alternative 6 projected to 2080. Drawing: NPS DSC eTIC No. CAHA 603 40065.

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]

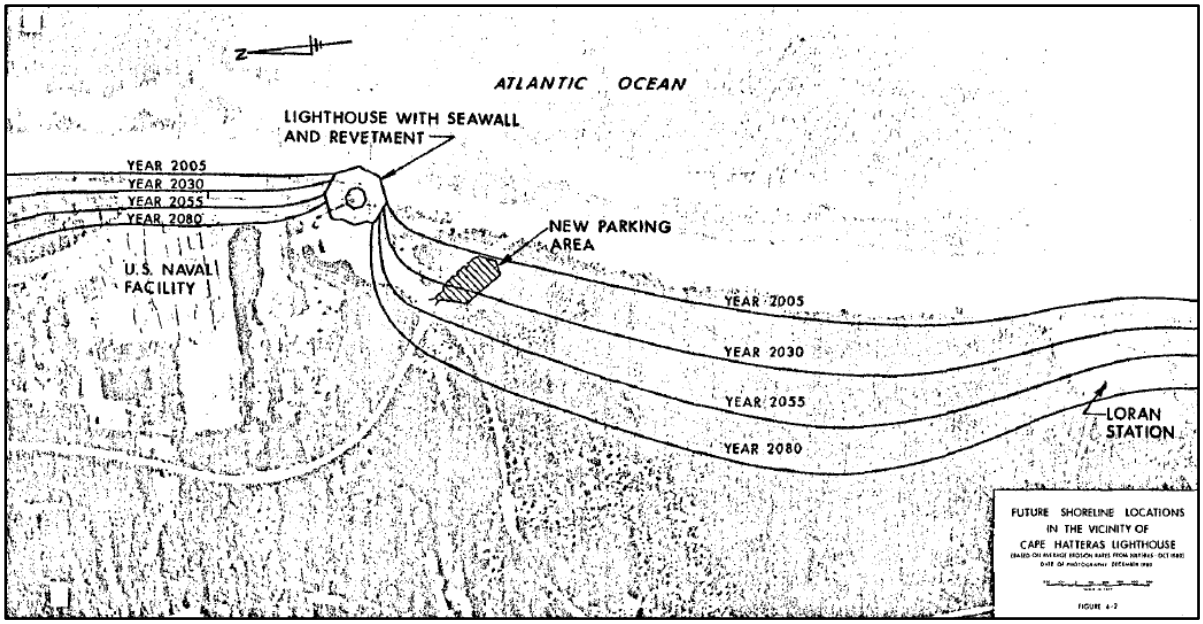

Figure 72. A 1985 plan by the ACOE showing the new revetment around the lighthouse and the predicted shorelines through year 2080. Drawing: NPS DSC eTIC No. CAHA 603 D160.

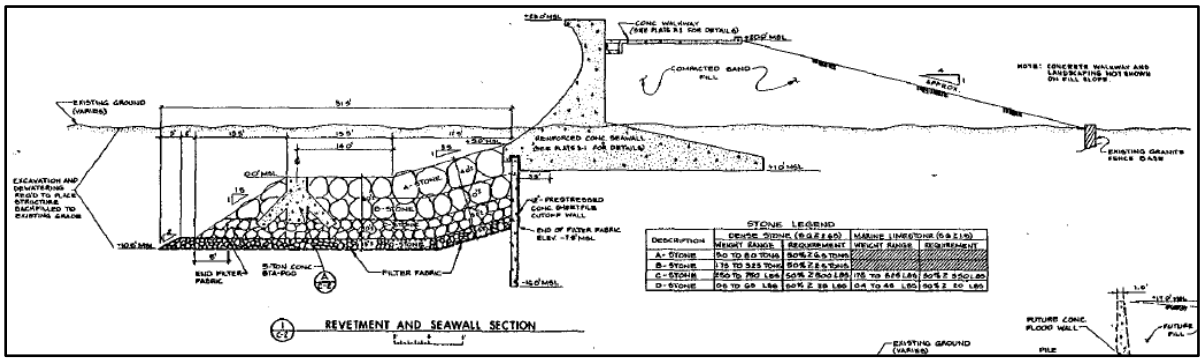

Figure 73. A cross section through the ACOE-designed revetment and seawall. The lighthouse would be located to the right. Drawing. NPS DSC eTIC No. CAHA 603 D160.

During the fall of 1985, the NPS contracted with Hesbrouck 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.

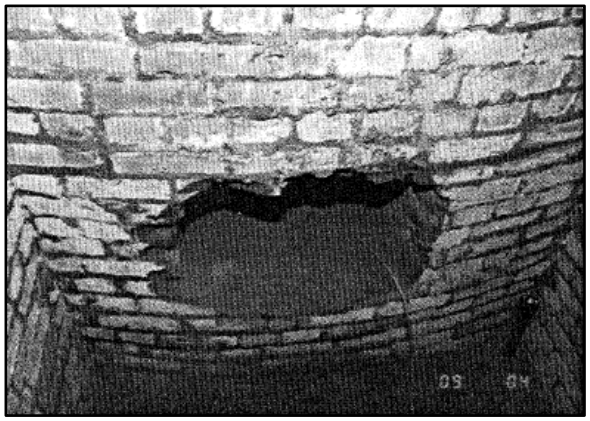

Figure 74. A 1985 view of the inspection opening from the inside of the wall cavity. Not efflorescence and solid joints. Photo: NPS DSC eTIC No. CAHA 603 D39.

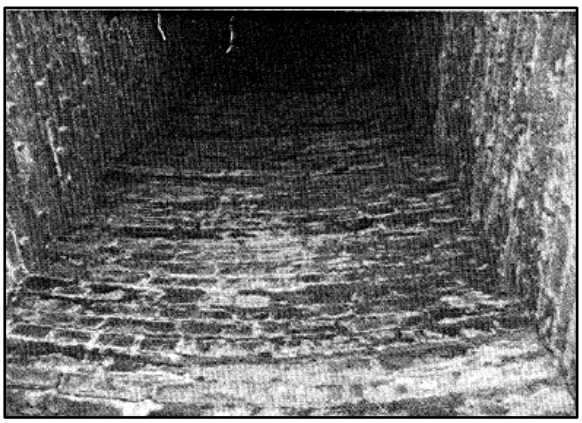

Figure 75. A 1985 view up the cavity shaft showing brickwork in good condition. Photo: NPS DSC eTIC No. CAHA 603 D39.

- 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.

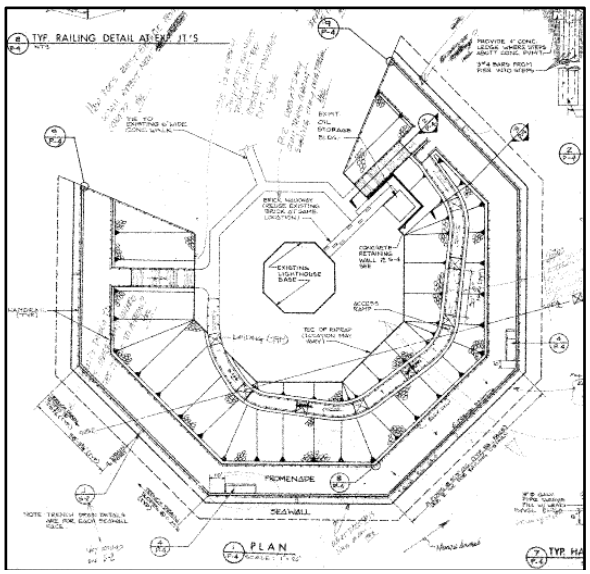

Figure 76. The plan of the seawall. Note the opening to the west, which would be later filled in once the ocean fully impeded on the site. Drawing: NPS DSC eTIC No. CAHA 603 41907.

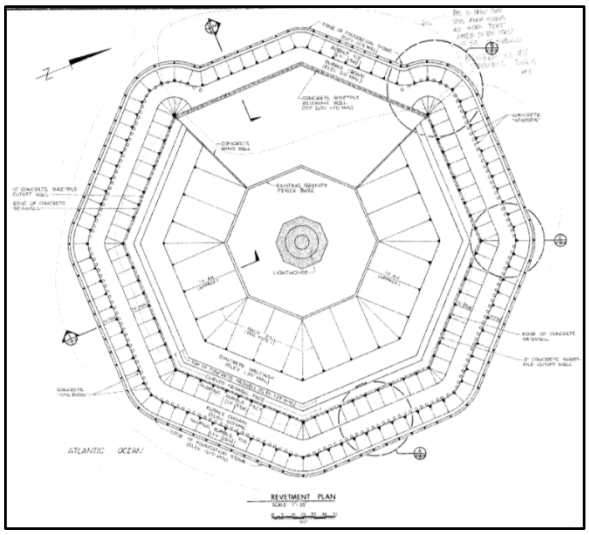

Figure 77. The plan of the concrete revetment. Drawing: NPS DSC eTIC No. CAHA 603 41907.

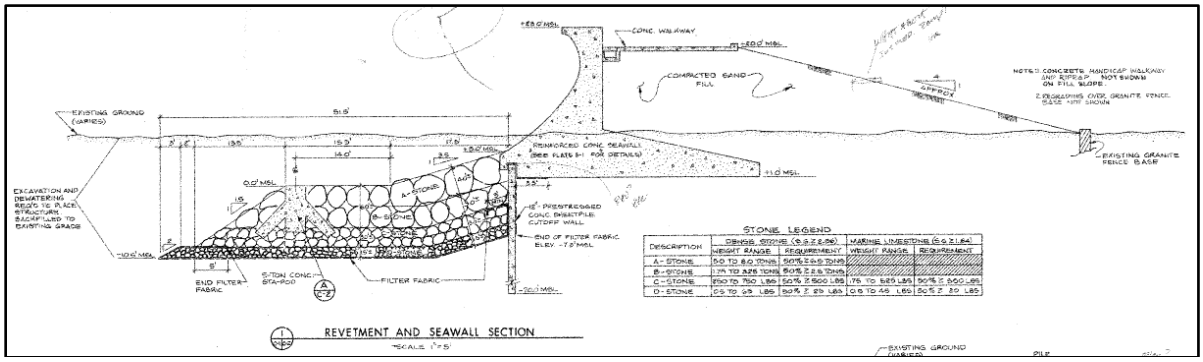

Figure 78. A section through the proposed seawall and revetment surrounding the lighthouse. Note: the lighthouse would be located to the right in the drawing. Drawing: NPS DSC eTIC No. CAHA 603 41907.

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.outerbanklighthousesociety.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 Keeper's 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 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]

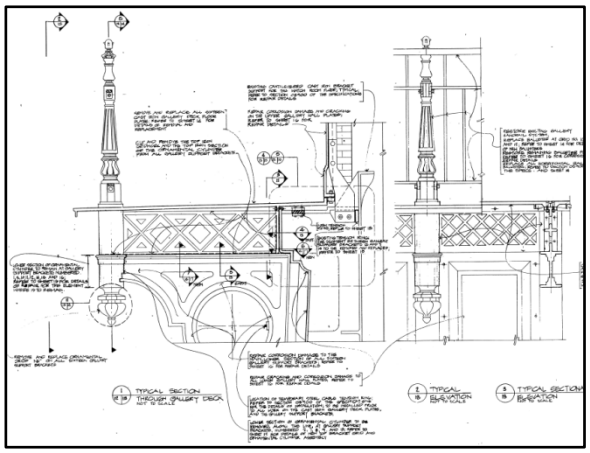


Figure 79. Preservation details for the gallery level cast-iron brackets, handrail, floor, etc. Drawing: NPS DSC eTIC No. CAHA 603 80020. Cropped by author.

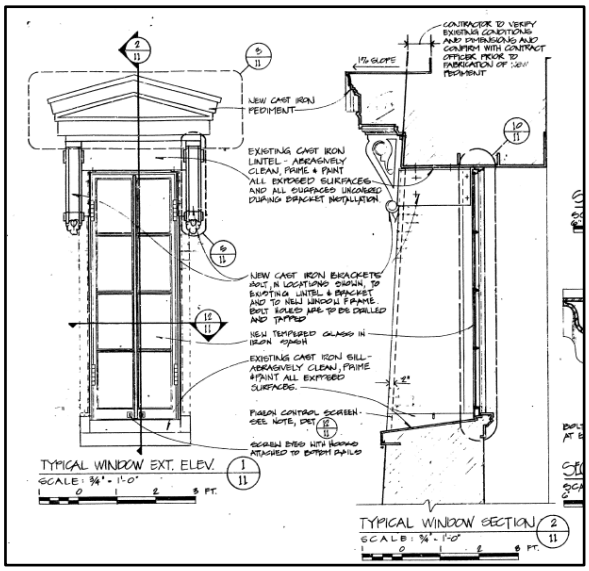


Figure 80. Details for the preservation of the exterior windows, including the hoods. Drawing: NPS DSC eTIC No. CAHA 603 80020. Cropped by author.

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 2,500 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 2,500 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]

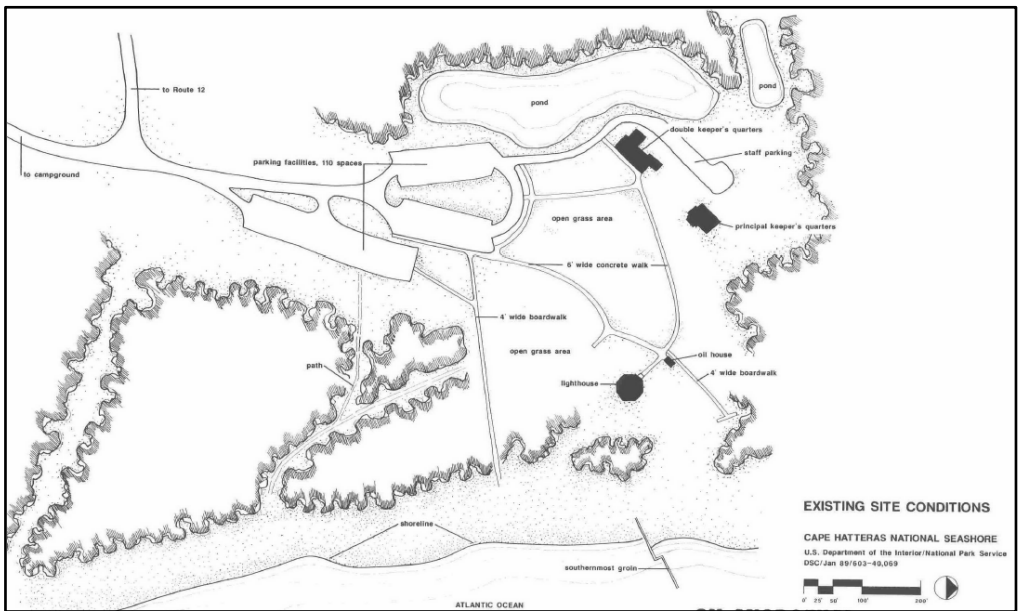


Figure 81, above. The existing site conditions in January 1989. Drawing: NPS DSC eTIC No. CAHA 603 D47A.

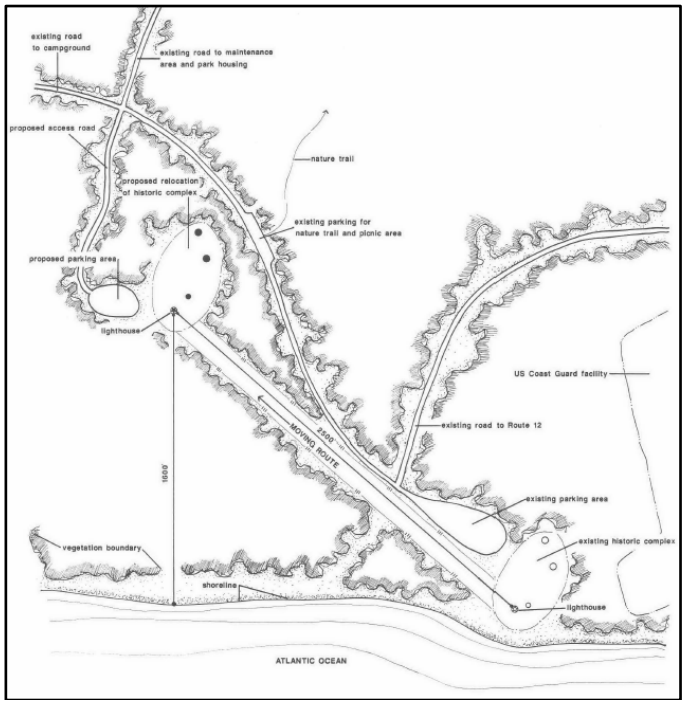


Figure 82, left. The proposed plan for relocation, as of January 1989. Drawing: NPS DSC eTIC No. CAHA 603 D47A. Cropped by author.

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

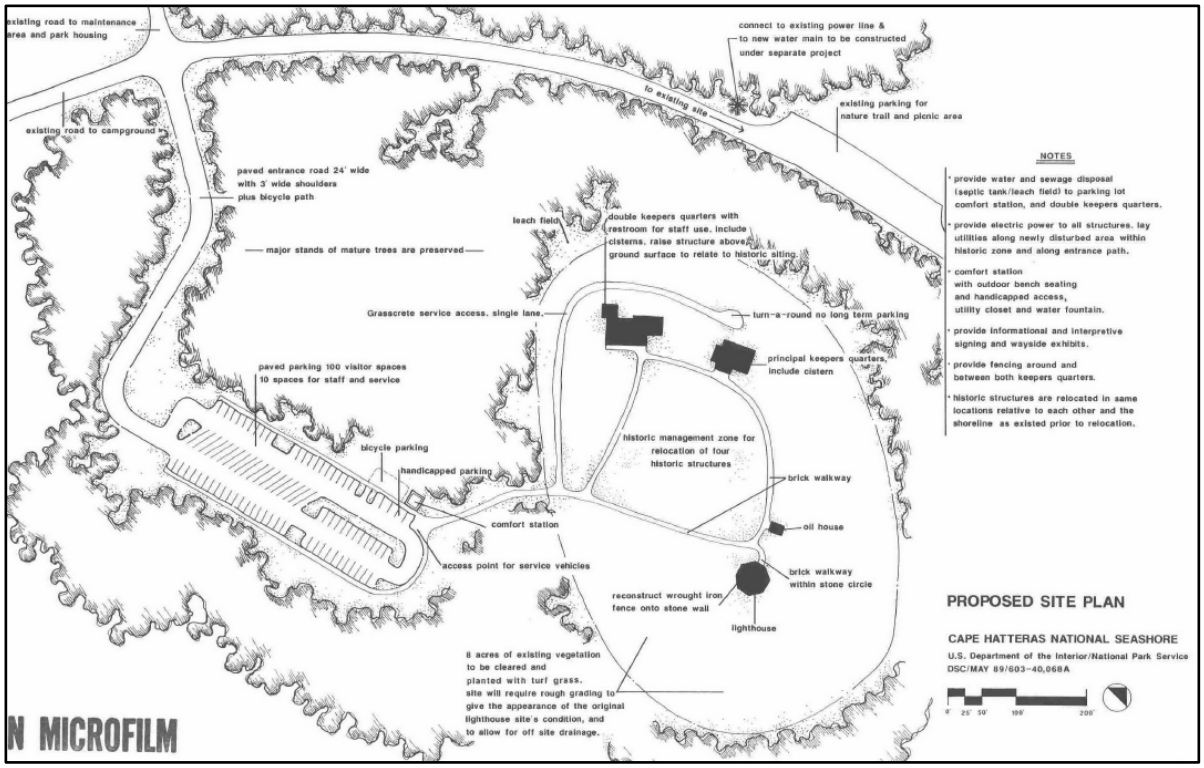


Figure 83. The proposed site plan, as of May 1989, after the move. Drawing: NPS DSC eTIC No. CAHA 603 D47A.

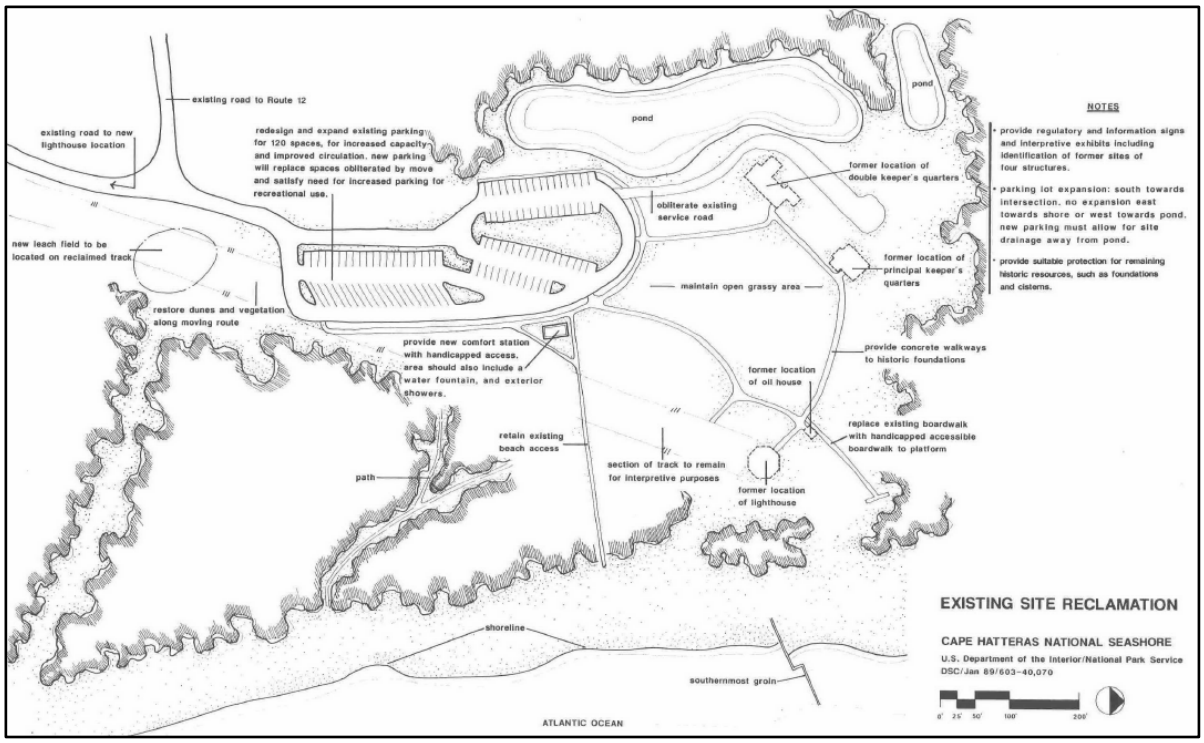


Figure 84. The proposed old lighthouse site after the move, as of January 1989. Drawing: NPS DSC eTIC No. CAHA 603 D47A.

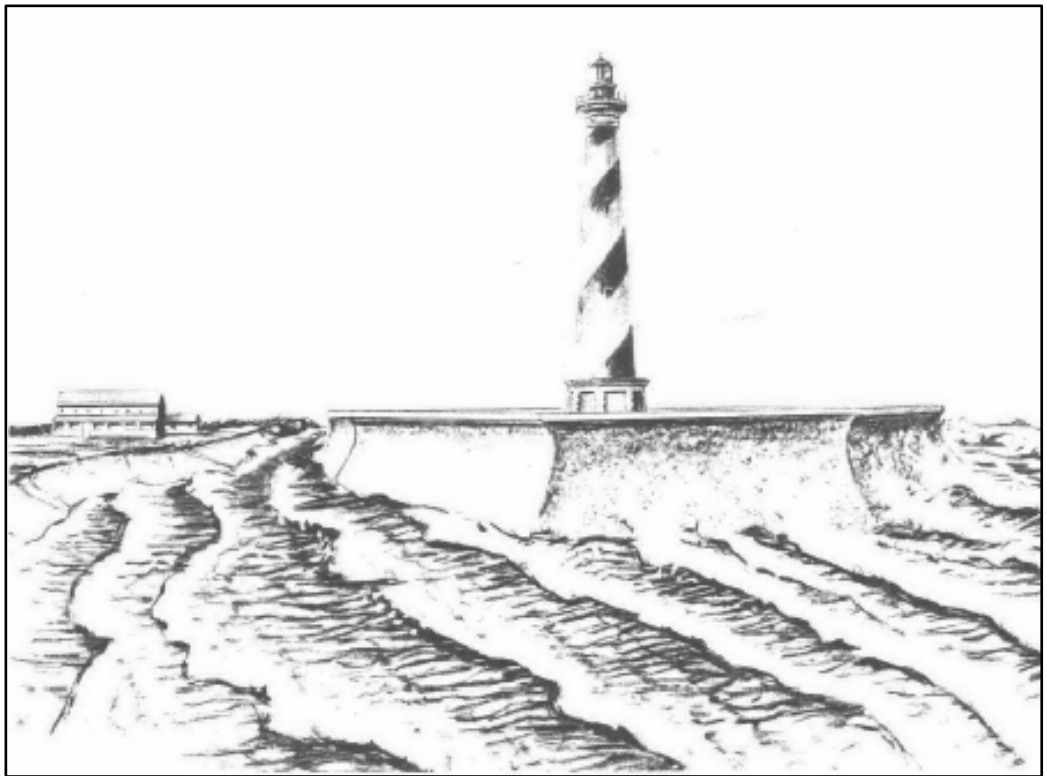


Figure 85, above. Rendering of the lighthouse and its seawall/revetment once the ocean overtakes the site. Drawing: NPS DSC eTIC No. CAHA 603 D47A.

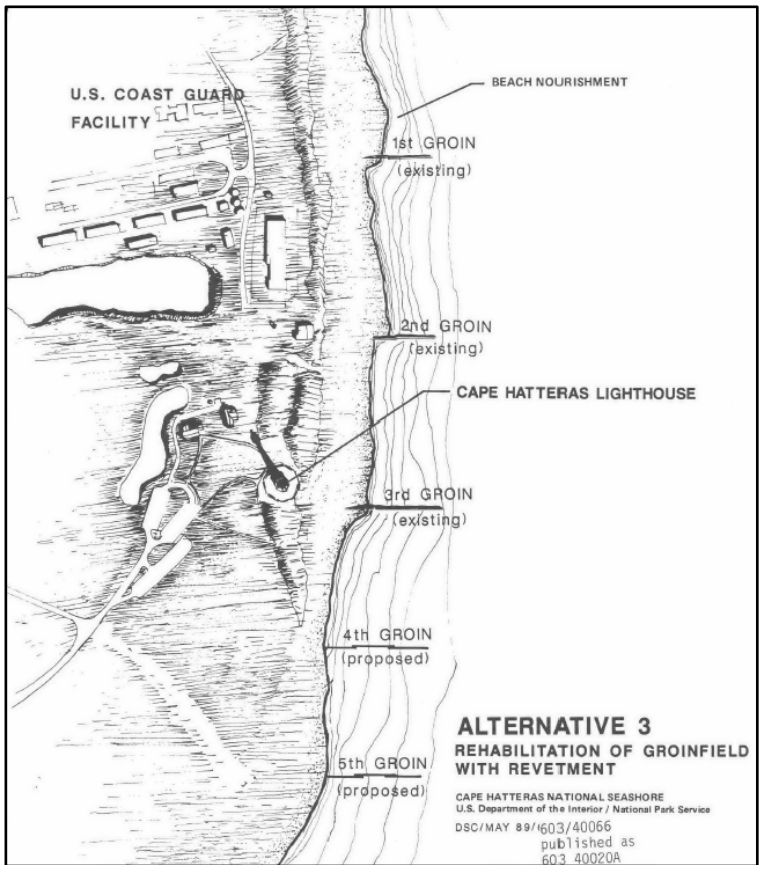


Figure 86, left. Alternative 3 included the installation of two new groins to the south, beach nourishment to the north, and a revetment around the lighthouse. Drawing: NPS DSC eTIC No. CAHA 603 D47A.

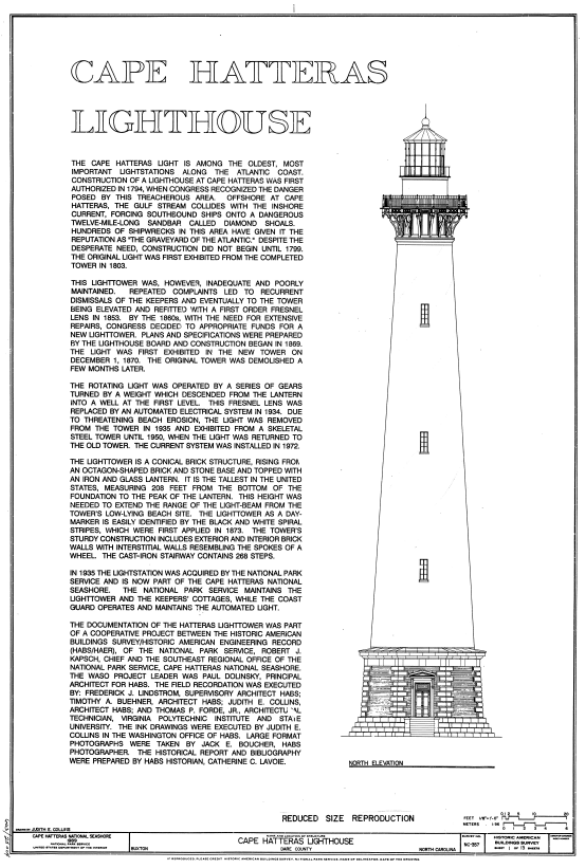
Public comment on the PA/DCP/EA was received through August 1989. Responses were divided. Forty-eight responses favored the move (including one with sixteen signatures). Fifty-six responses opposed the move (including one with 4,516 signatures). Seven responses had no opinion.[266]

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 "AL 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
DARE COUNTY
NORTH CAROLINA

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:

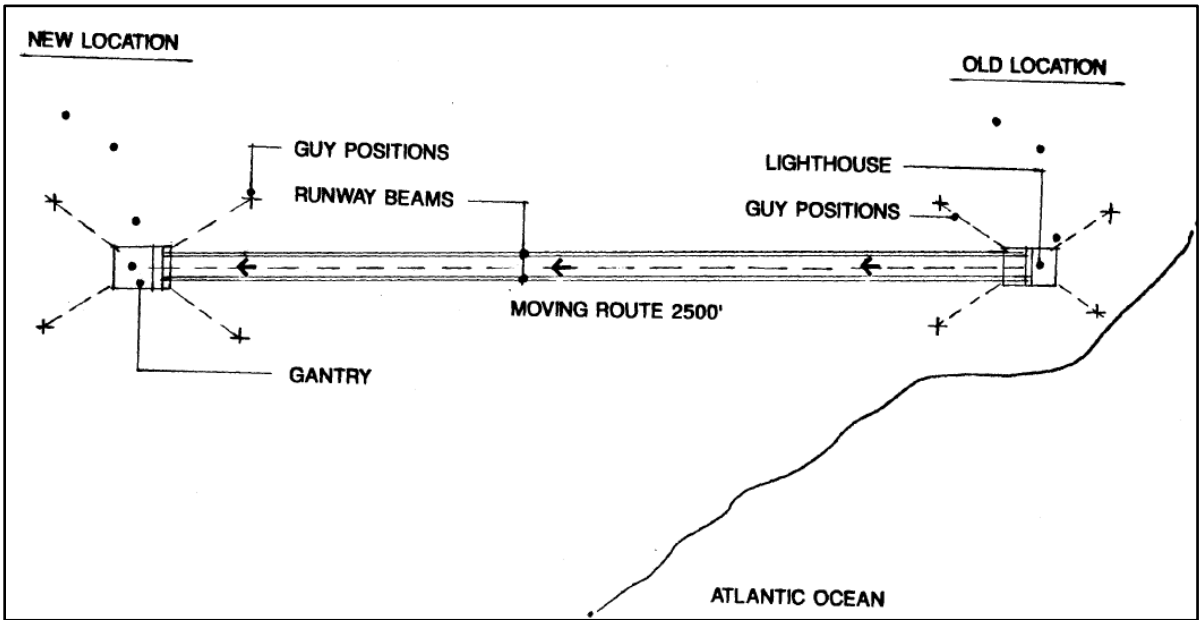
- Removal of portions of the stair to make new castings from the old pieces.
- Removal of the cast-iron handrail for preservation work.
- Removal of the Service Room windows, casting of new pieces, and reinstallation with 0'-1" safety glass.
- Completion restoration of the Lantern with new 5/16" safety 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."



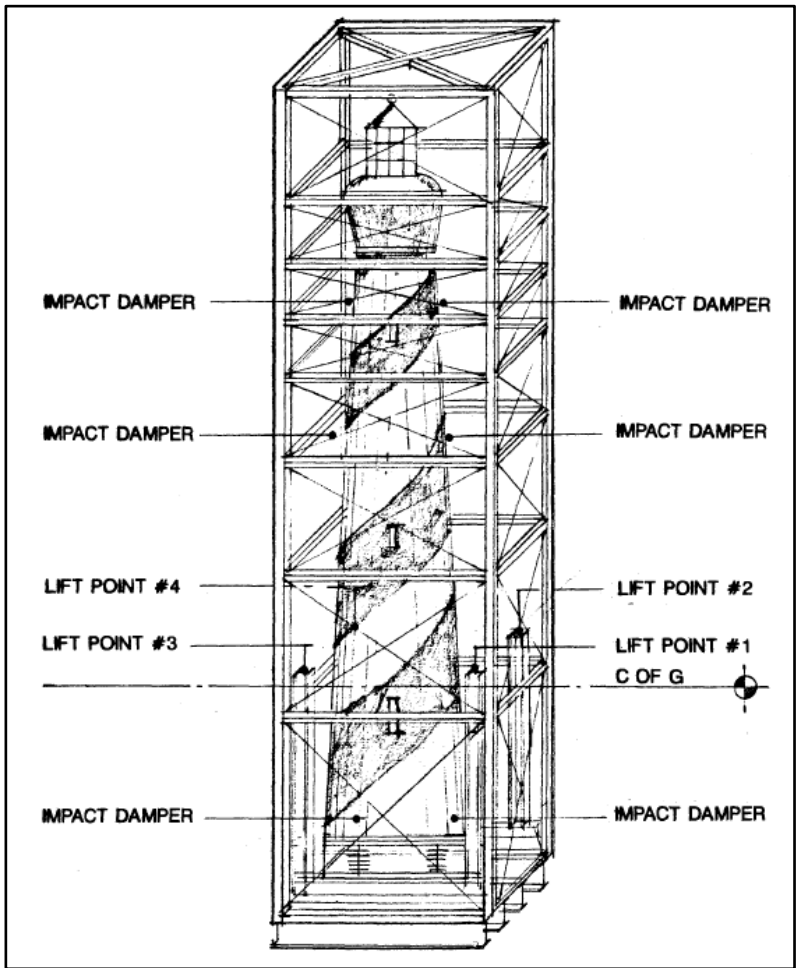


Figure 88, above. The location of the runway, gantry, and guy tower positions as proposed in November 1991 by HNTB. Drawing: NPS DSC eTIC No. CAHA 603 D118. Cropped by author.

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.

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[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.

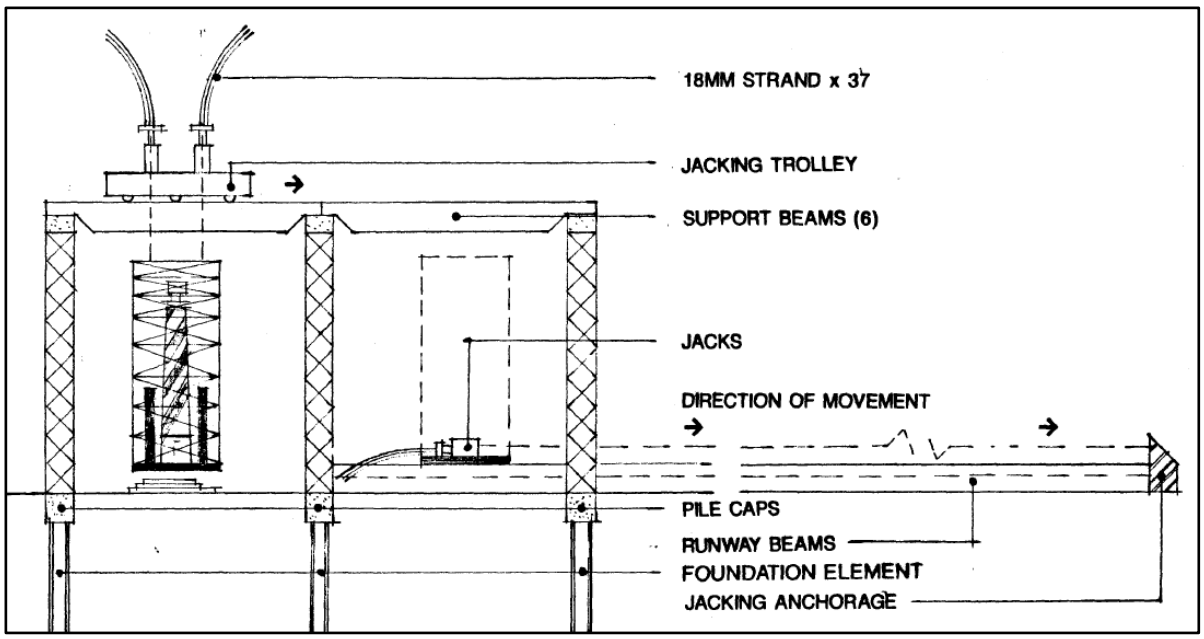

Figure 90. A drawing of the general arrangement of the gantry system as proposed in November 1991 by HNTB. Drawing: NPS DSC eTIC No. CAHA 603 D118. Cropped by author.

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."

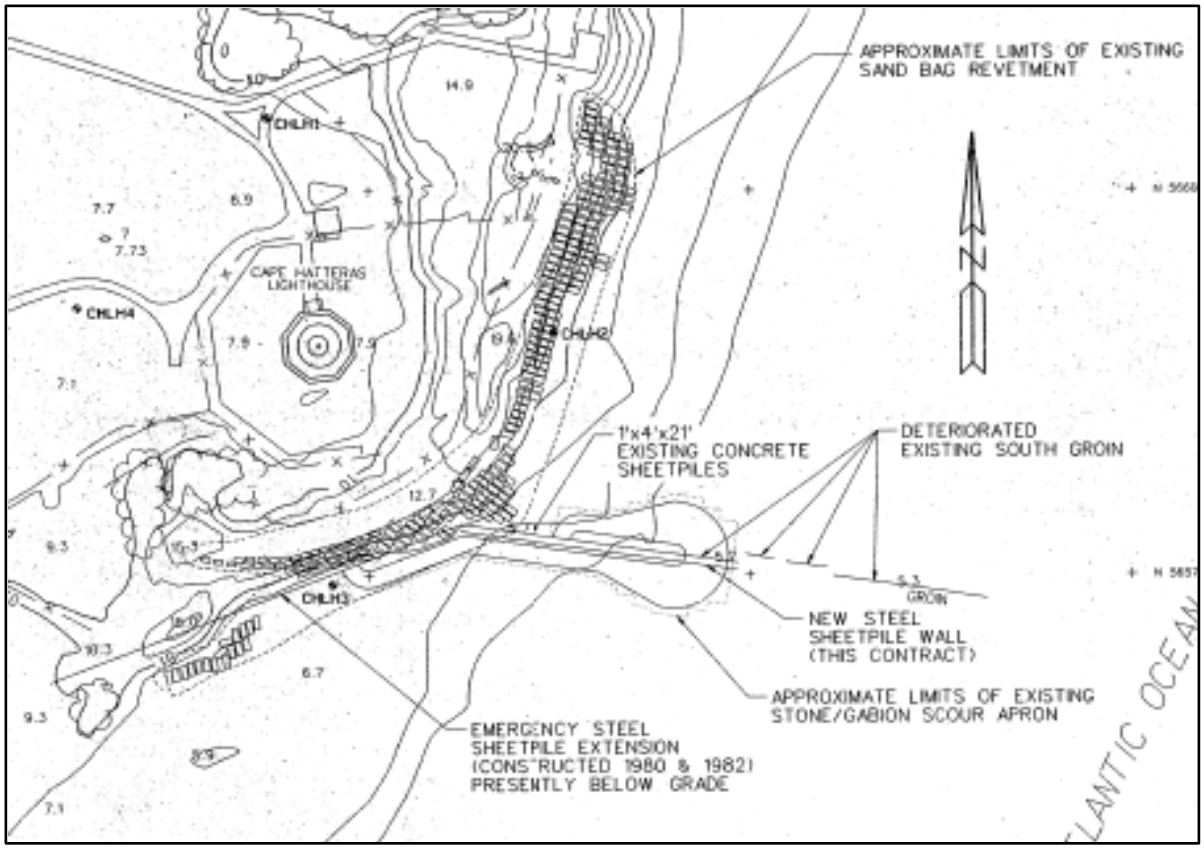

Figure 91. Plans for the repair of the south groin. Drawing: NPS DSC eTIC No. CAHA 603 80052. Cropped by author.

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 Presdient 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. They money would be available during fiscal year 1998, allowing the NPS to plan and prepare for the relocation of the lighthouse.[291]

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 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.[293] 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.[294] Based on these suggestions, the DSC design team edited their Phase II design, which was re-released in June 1998 (fig. 92).[295] A final design analysis for the Phase II work was completed in August 1998 with final drawings being completed in January 1999.[296]

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[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.
[293] Denver Service Center, National Park Service. "Lighthouse Move Phase II." *8 sheets*. September 1997. NPS DSC eTIC No. CAHA 603 41024.
[294] 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.
[295] Denver Service Center, National Park Service. "Lighthouse Move Phase II." *15 sheets*. June 1998. NPS DSC eTIC No. CAHA 603 41024A.
[296] 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.

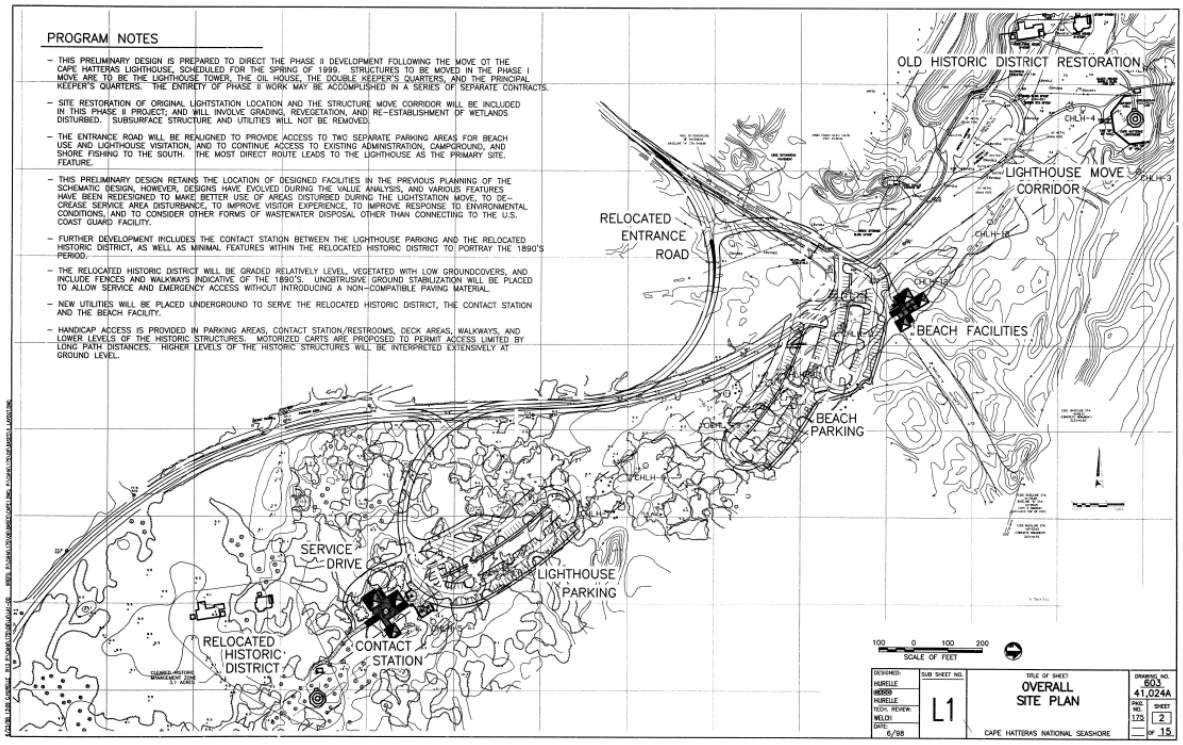

Figure 92. A site plan for Phase II (redevelopment) of the project as submitted in June 1998. Drawing: NPS DSC eTIC No. CAHA 603 41024.

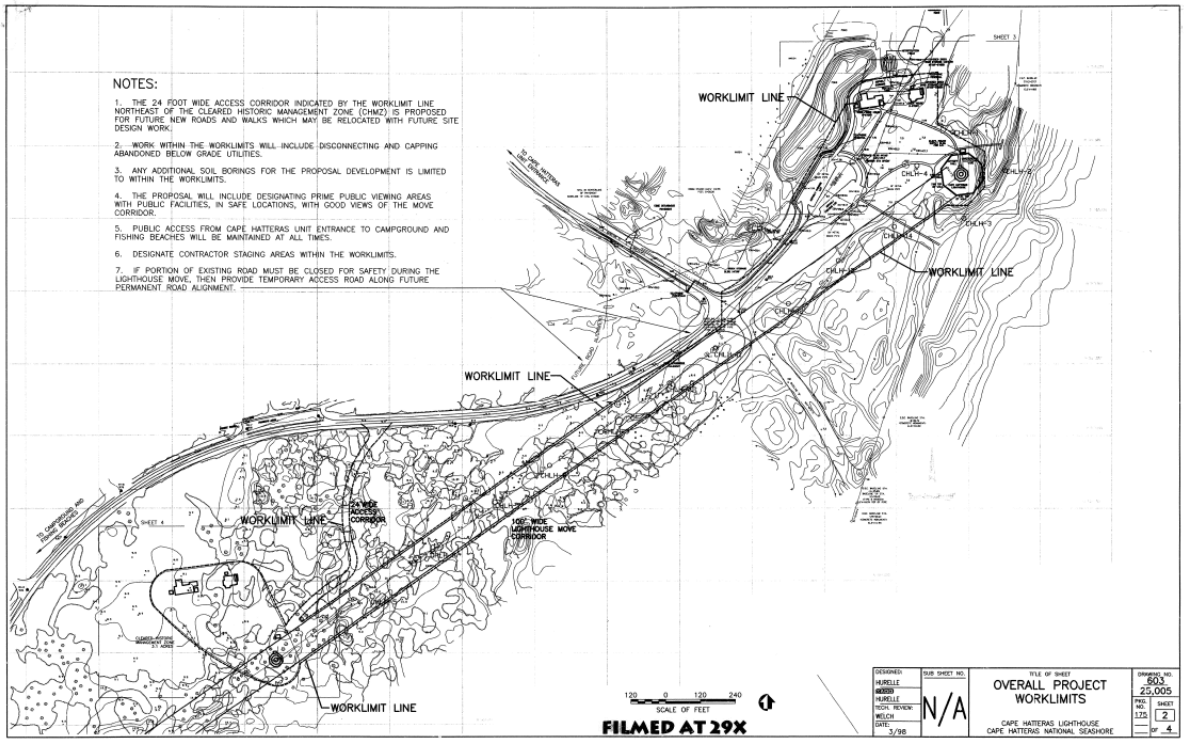

Figure 93. The overall project work limits in the solicitation for bid drawings, March 1998. Drawing: NPS DSC eTIC No. CAHA 603 25005.

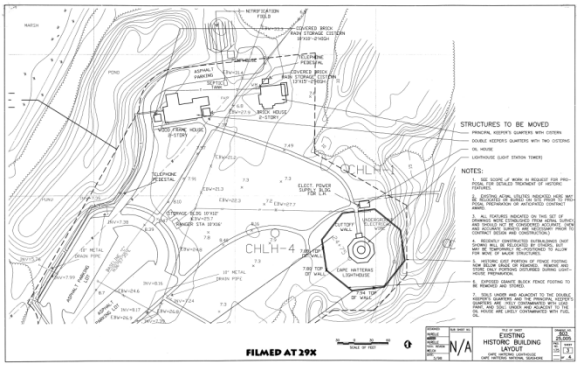

Figure 94. The existing historic building layout. Drawing: NPS DSC eTIC No. CAHA 603 25005.

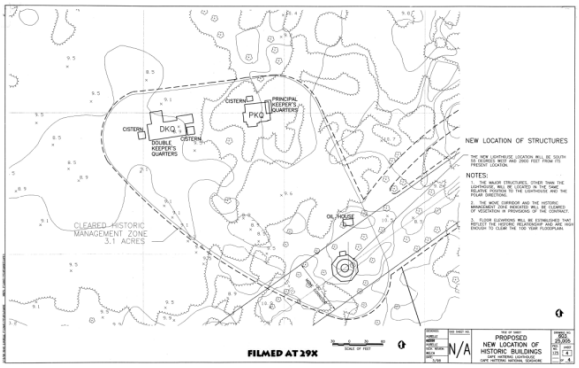

Figure 95. The proposed new location of historic buildings. Drawing: NPS DSC eTIC No. CAHA 603 25005.

In March 1998, DSC released solicitation-for-bid drawings entitled "Existing Conditions/Proposed Building Relocation" (figs. 93-95).[297] Related contract and construction specifications have not been located; therefore details for this phase cannot be provided by the author.

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. . . .[298]

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 on behalf of North Carolina Governor James Hunt, urging the move be supported.[299] 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.[300]

International Chimney Incorporated (ICC) won the contract to move the light station. Their final proposal supplementation for the move was submitted in May 1998 (the original proposal could not be located; therefore details for this phase cannot be provided by the author).[301] 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

[297] Denver Service Center, National Park Service. "Existing Conditions/Proposed Building Relocation." March 1998. NPS DSC eTIC No. CAHA 603 25005.
[298] Shelton-Roberts, "The Hatteras Move: A Century of Debate."
[299] 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.
[300] Ibid.
[301] 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.

(compressive strengths, unit weights, and moduli of elasticity), and depth of debris within wall cavities.[302]

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.[303]

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.[304]

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. . . ."[305]

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 recommended performing *in situ* load testing of the stairs in landings in order to determine their live-load capacity.[306]
In October, the first draft Design Development Drawings for the relocation were completed by DSC,[307] *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.,[308] and *Health and Safety Plan for Construction* was completed by LAW Engineering and Environmental Services, Inc. for ICC.[309]

In April 1999, Final Construction Drawings for the relocation were completed (figs. 96-112).[310]

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[302] 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.
[303] 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.
[304] 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.
[305] 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.
[306] 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.
[307] 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.
[308] 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.
[309] 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.
[310] 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.

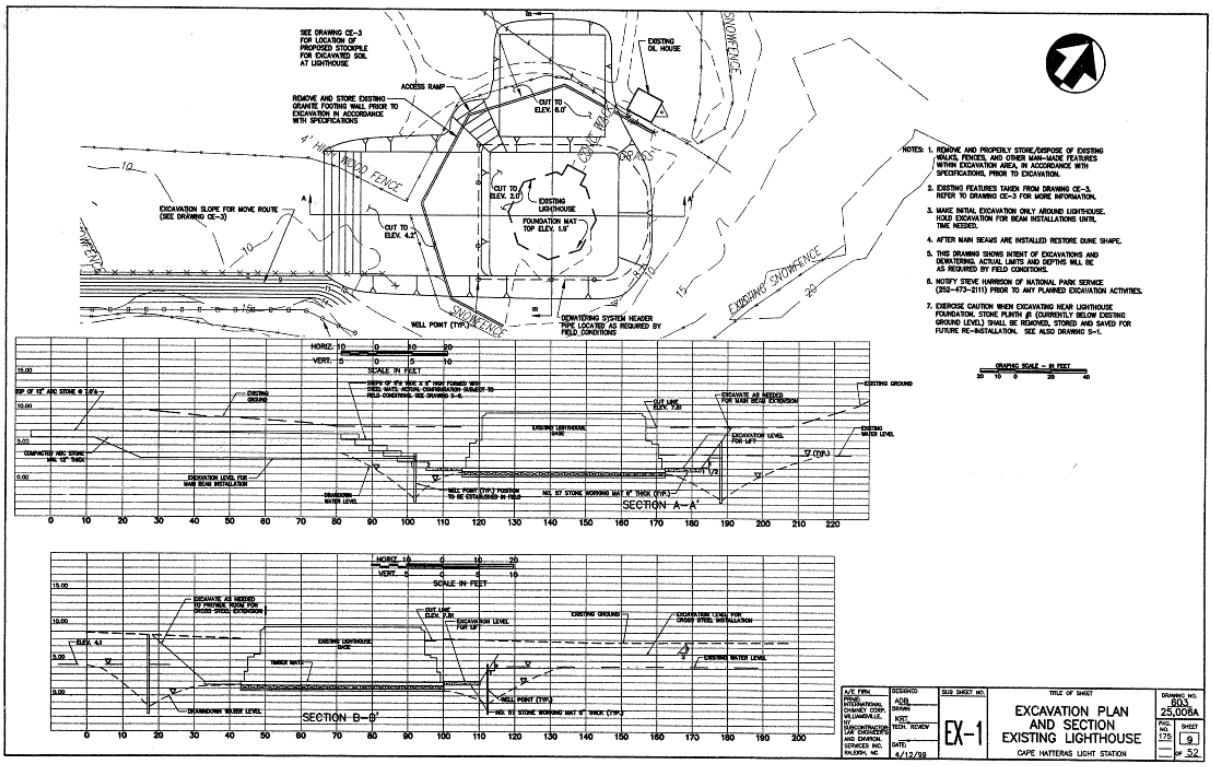


Figure 96. The excavation plan and sections for the lighthouse in its existing location. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

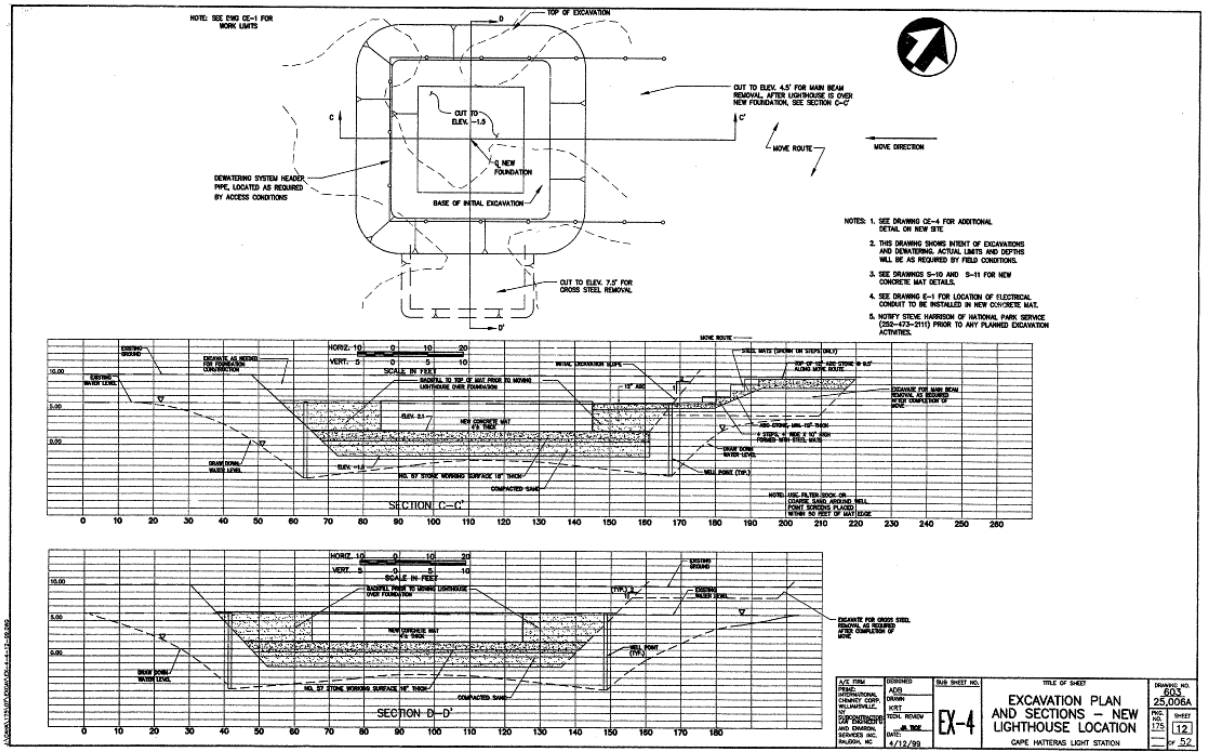


Figure 97 The excavation plan and sections for the new foundation for the lighthouse. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

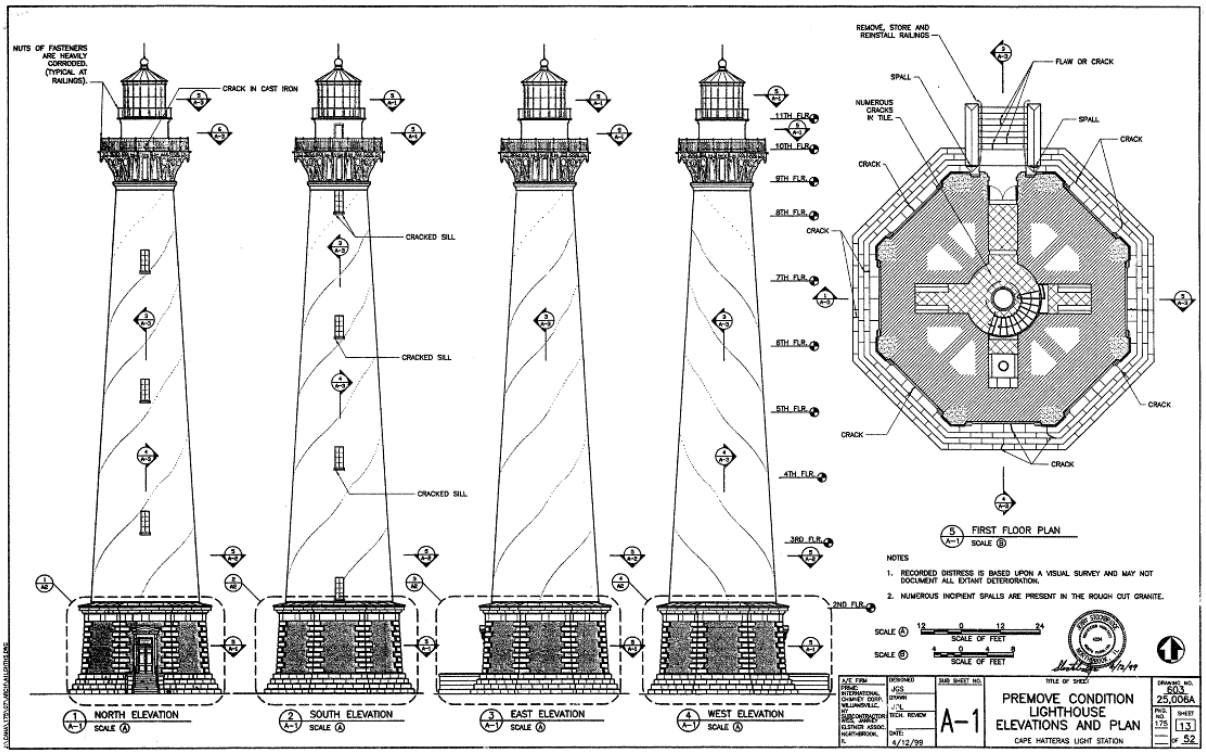


Figure 98. The pre-move conditions of the lighthouse – elevations and first-floor plan. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

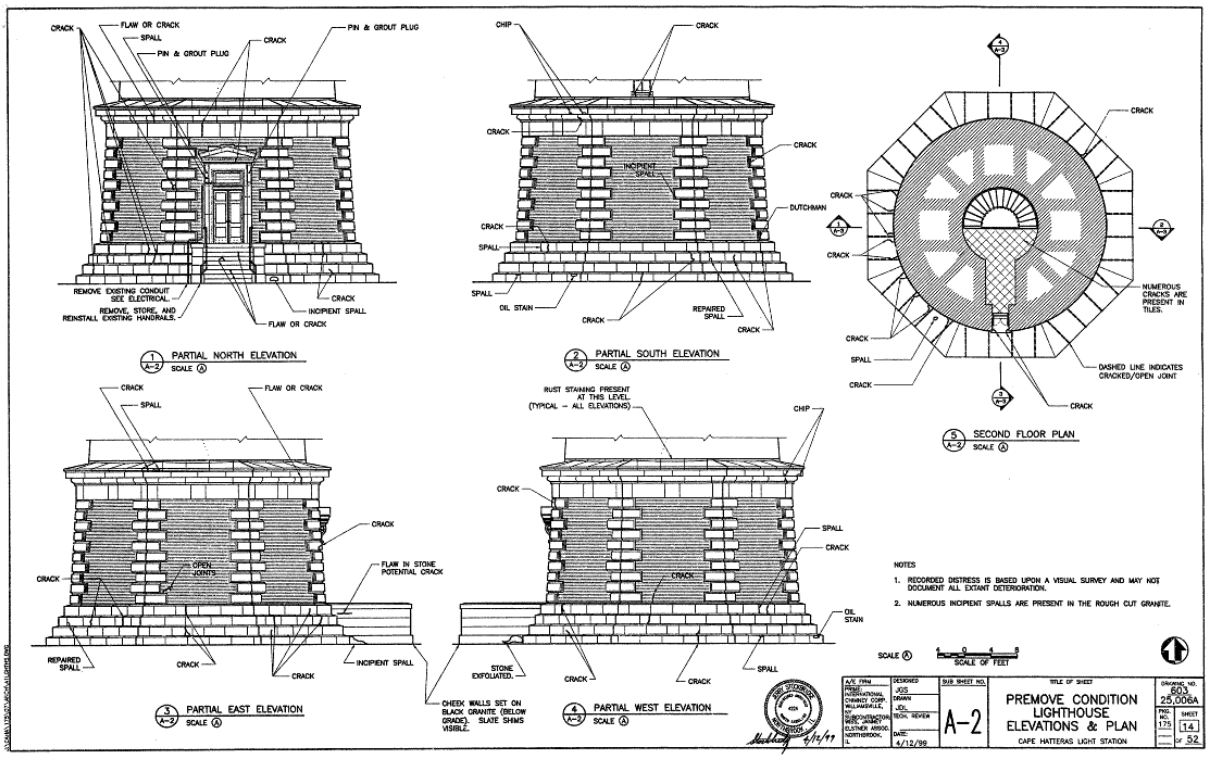


Figure 99. The pre-move conditions of the lighthouse base – elevations and second-floor plan. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

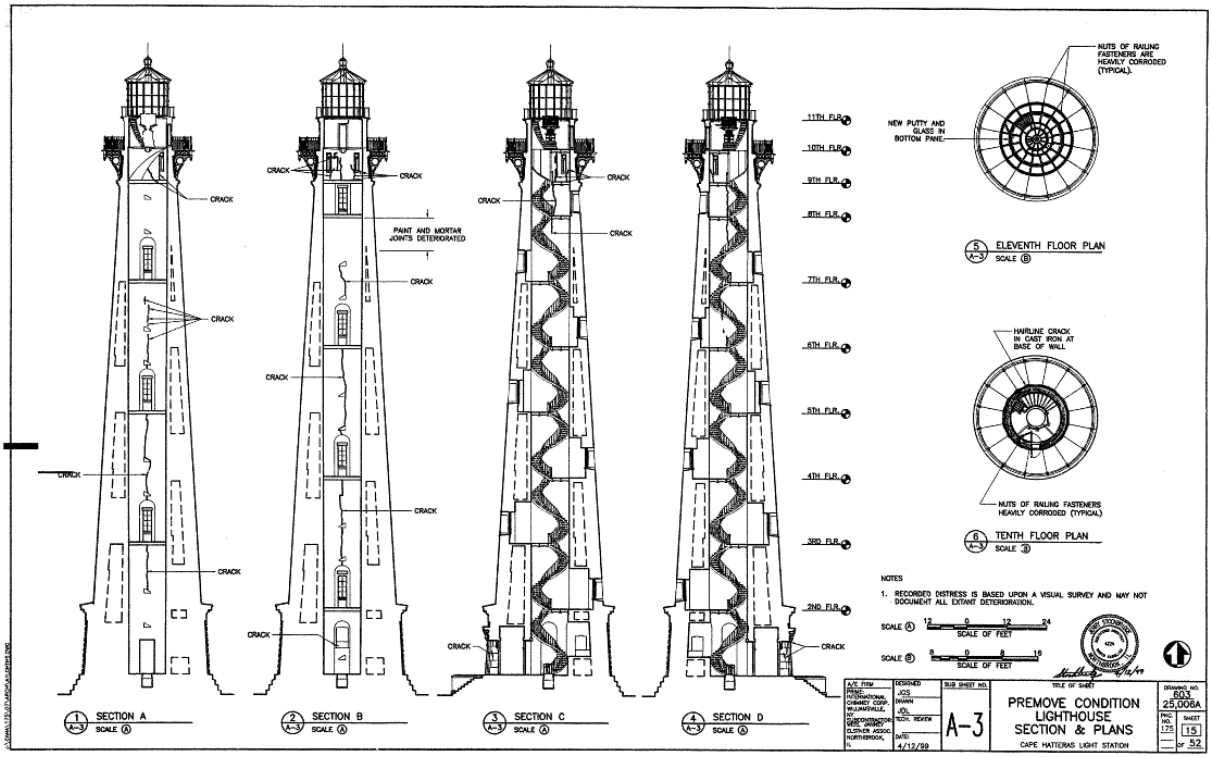


Figure 100. The pre-move conditions of the lighthouse – interior elevations and tenth- and eleventh-floor plan. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

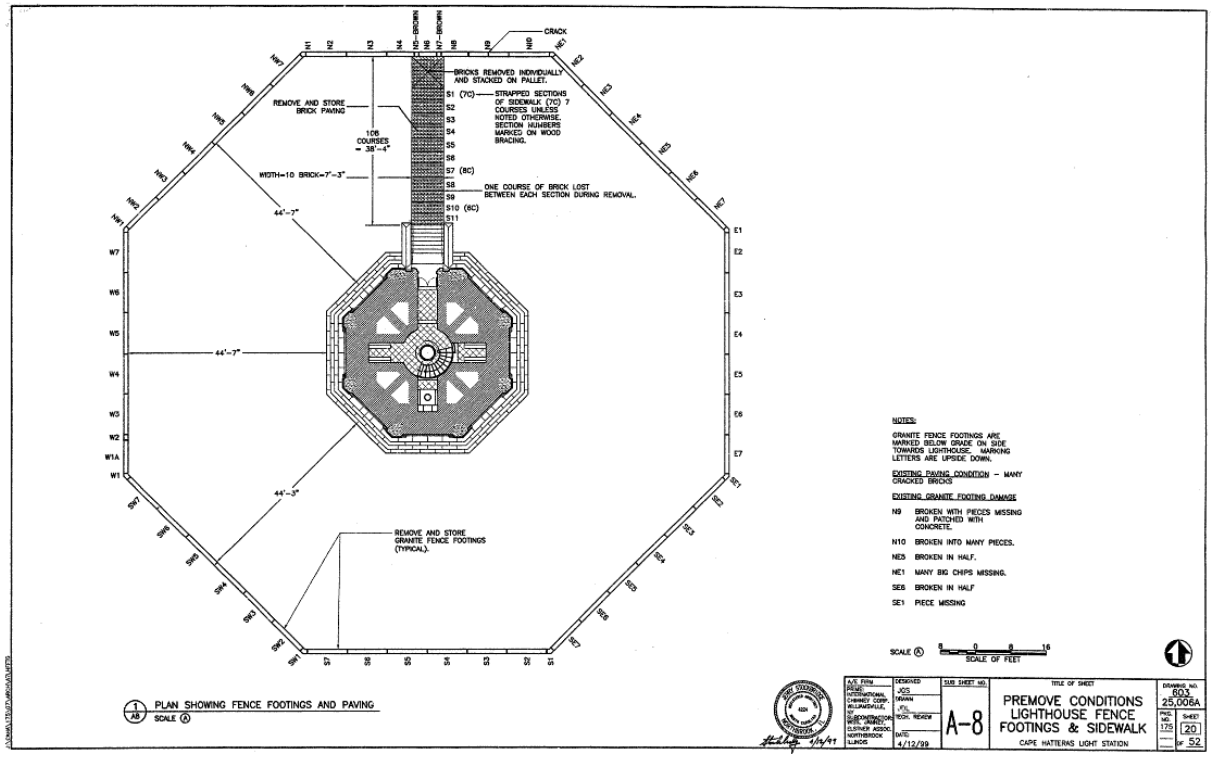
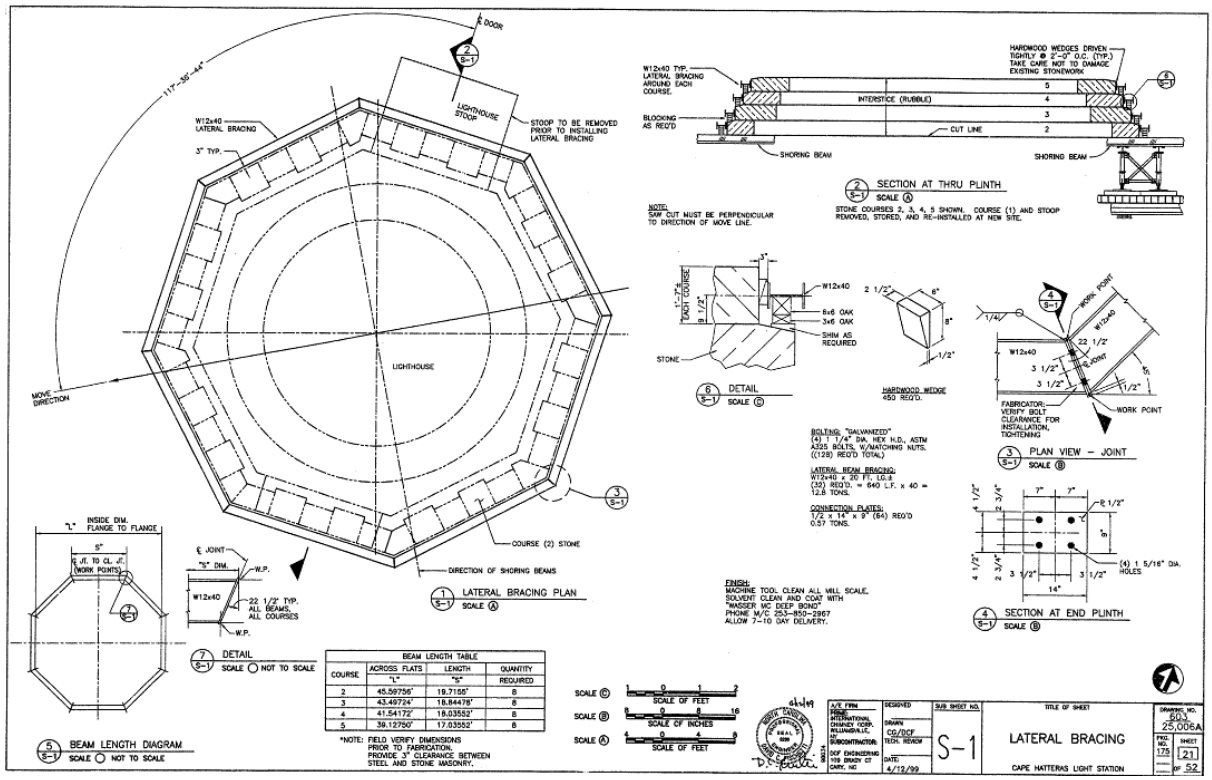


Figure 101. The pre-move conditions of the lighthouse fence footings and sidewalk. Drawing: NPS DSC eTIC No. CAHA 603 25006A.



COURSE	BEAM LENGTH TABLE ACROSS FLATS "L"	LENGTH "S"	QUANTITY REQUIRED
2	45.59756'	19.7158'	8
3	43.49724'	18.84478'	8
4	41.54172'	18.03552'	8
5	39.12750'	17.03552'	8

*NOTE: FIELD VERIFY DIMENSIONS PRIOR TO FABRICATION. PROVIDE 3" CLEARANCE BETWEEN STEEL AND STONE MASONRY.

Figure 102. The design for the lateral bracing at the lighthouse foundation. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

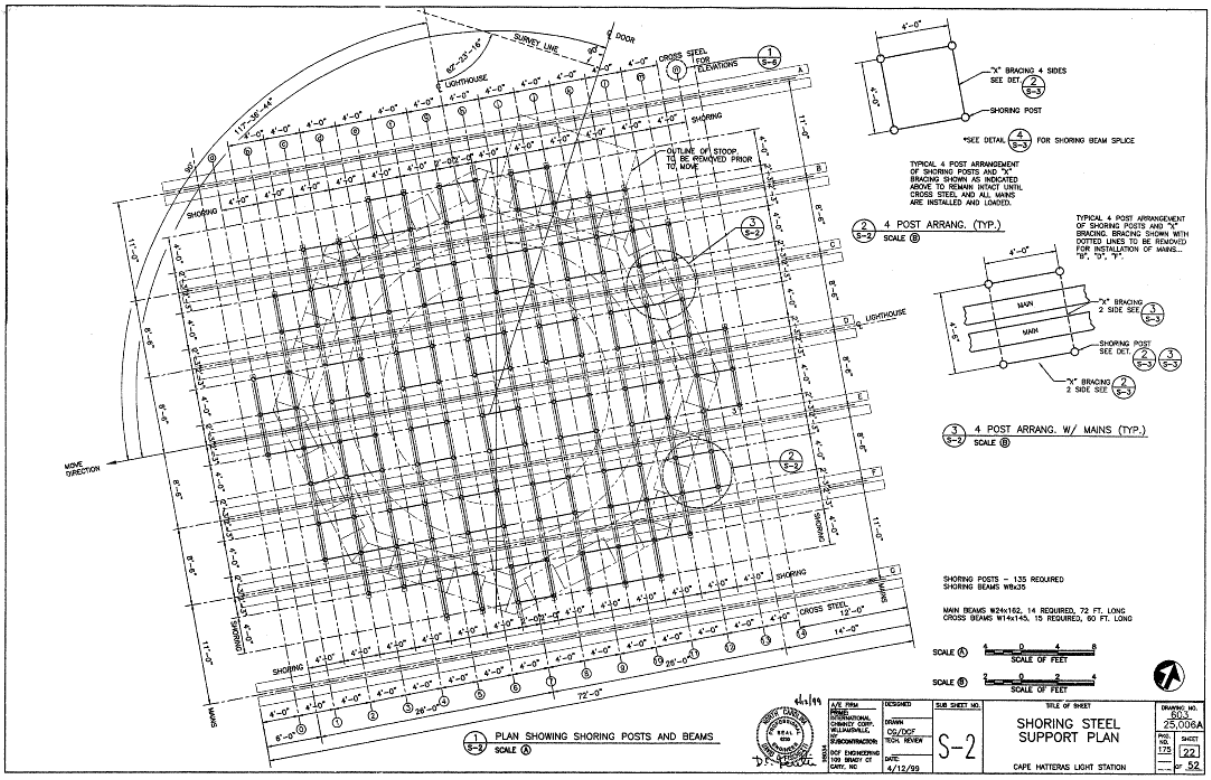


Figure 103. The design for the shoring steel support under the lighthouse (plan). Drawing: NPS DSC eTIC No. CAHA 603 25006A.

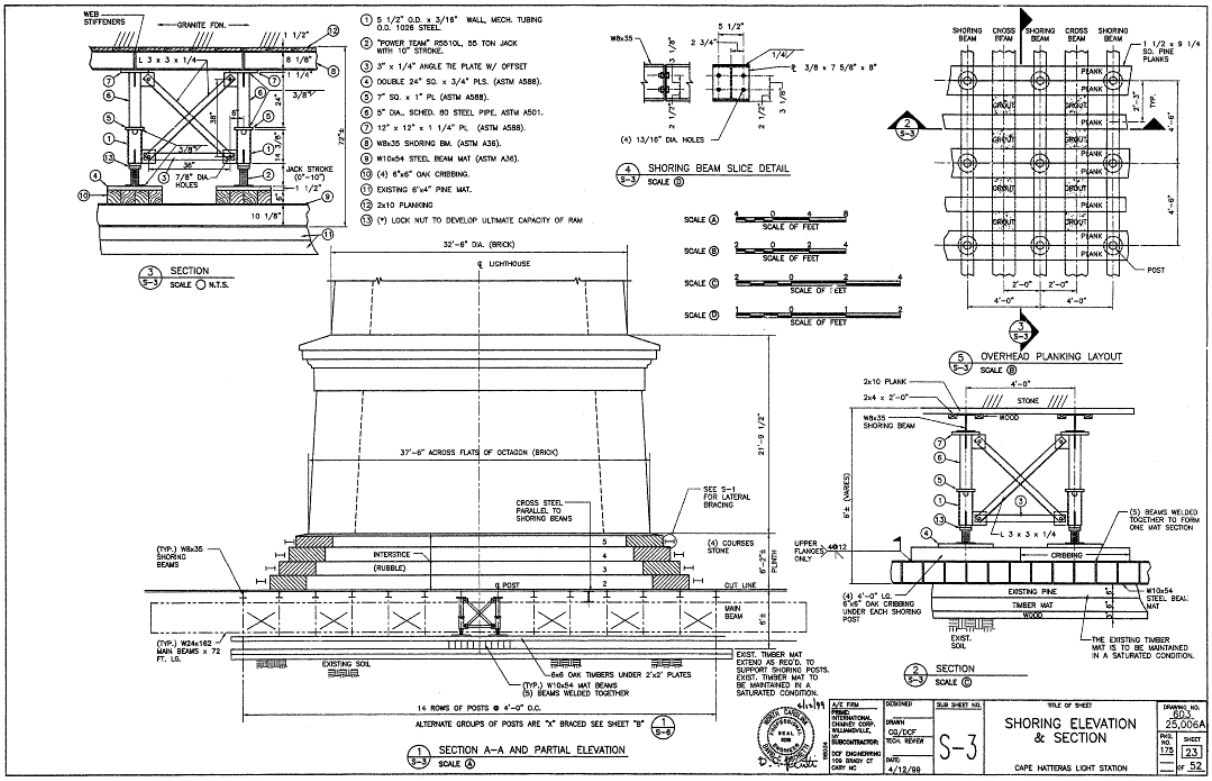


Figure 104. The design for the shoring steel support under the lighthouse (elevation and section). Drawing: NPS DSC eTIC No. CAHA 603 25006A.

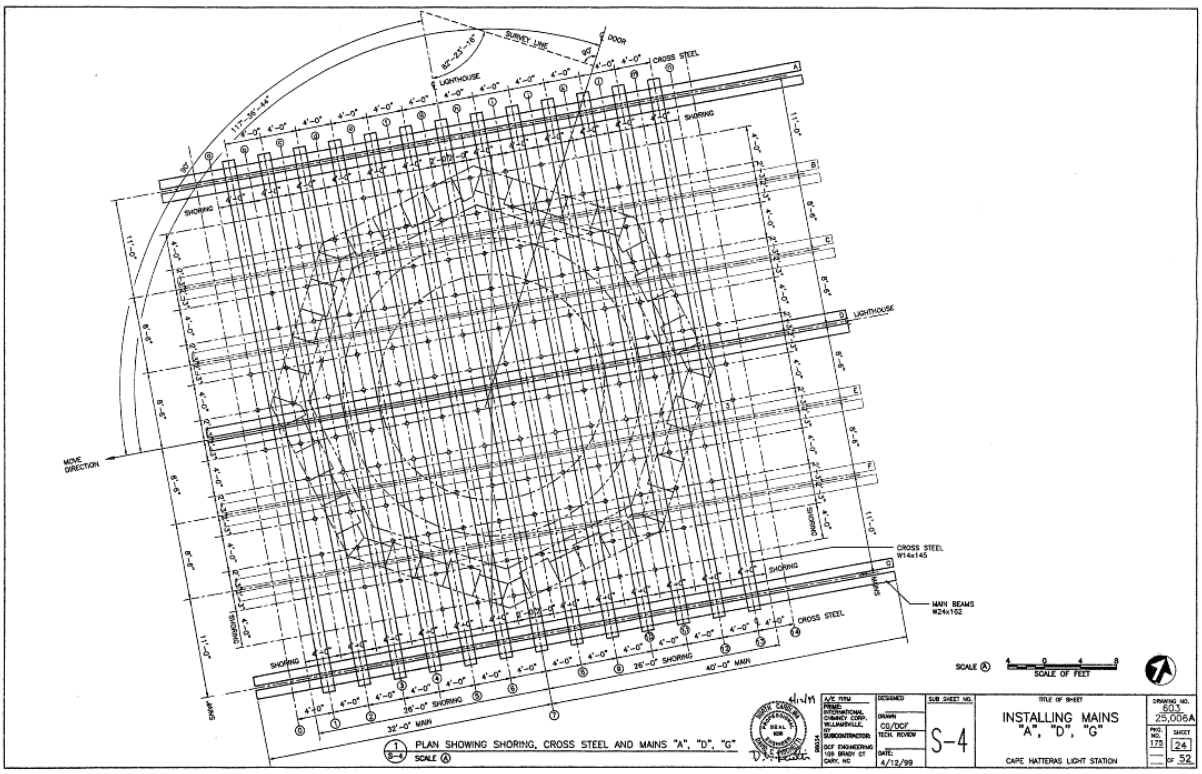


Figure 105. The design for installation the mains A, D, and G (plan). Drawing: NPS DSC eTIC No. CAHA 603 25006A.

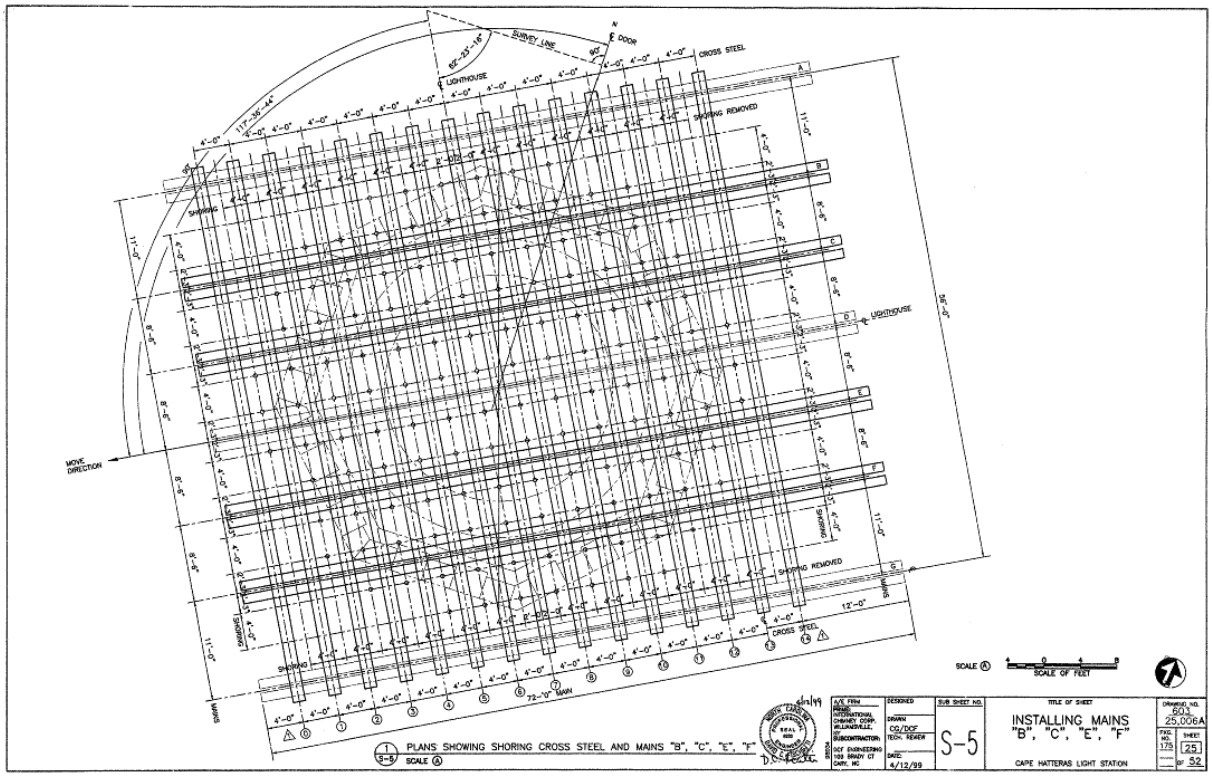


Figure 106. The design for installation the mains B, C, E, and F (plan). Drawing: NPS DSC eTIC No. CAHA 603 25006A.

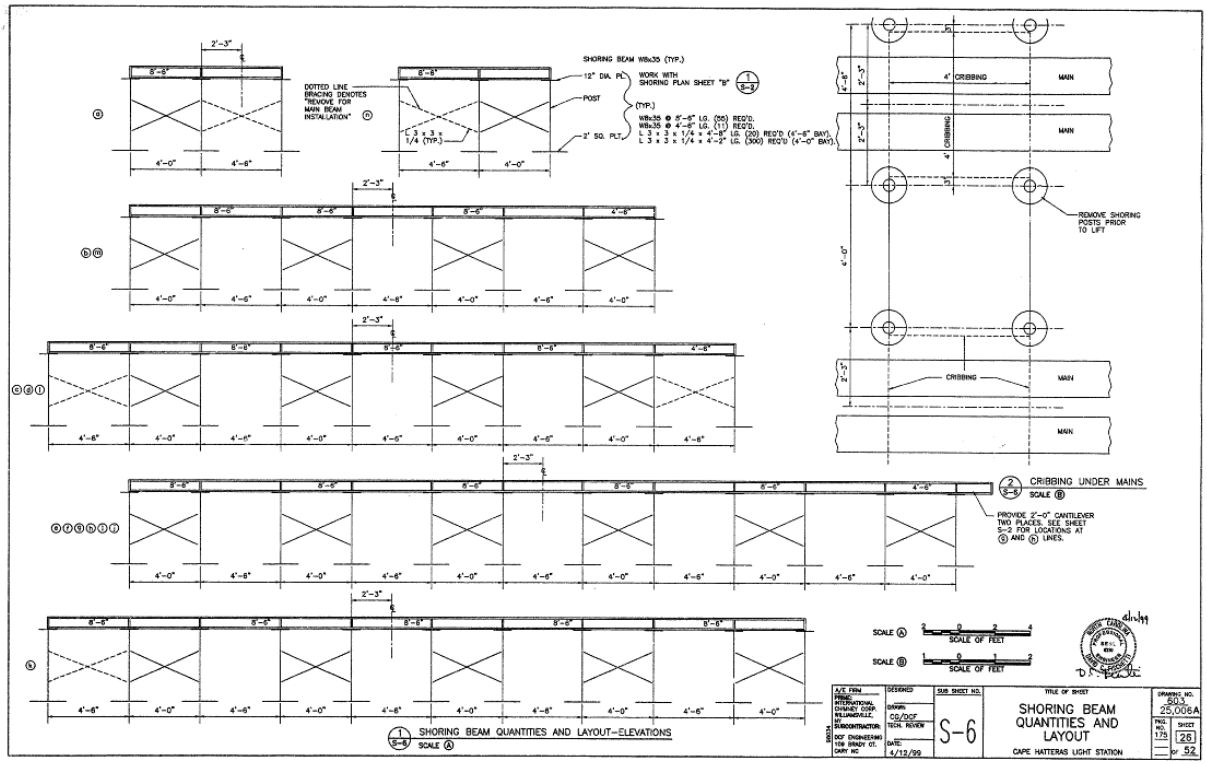


Figure 107. The design for installation of the shoring beams. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

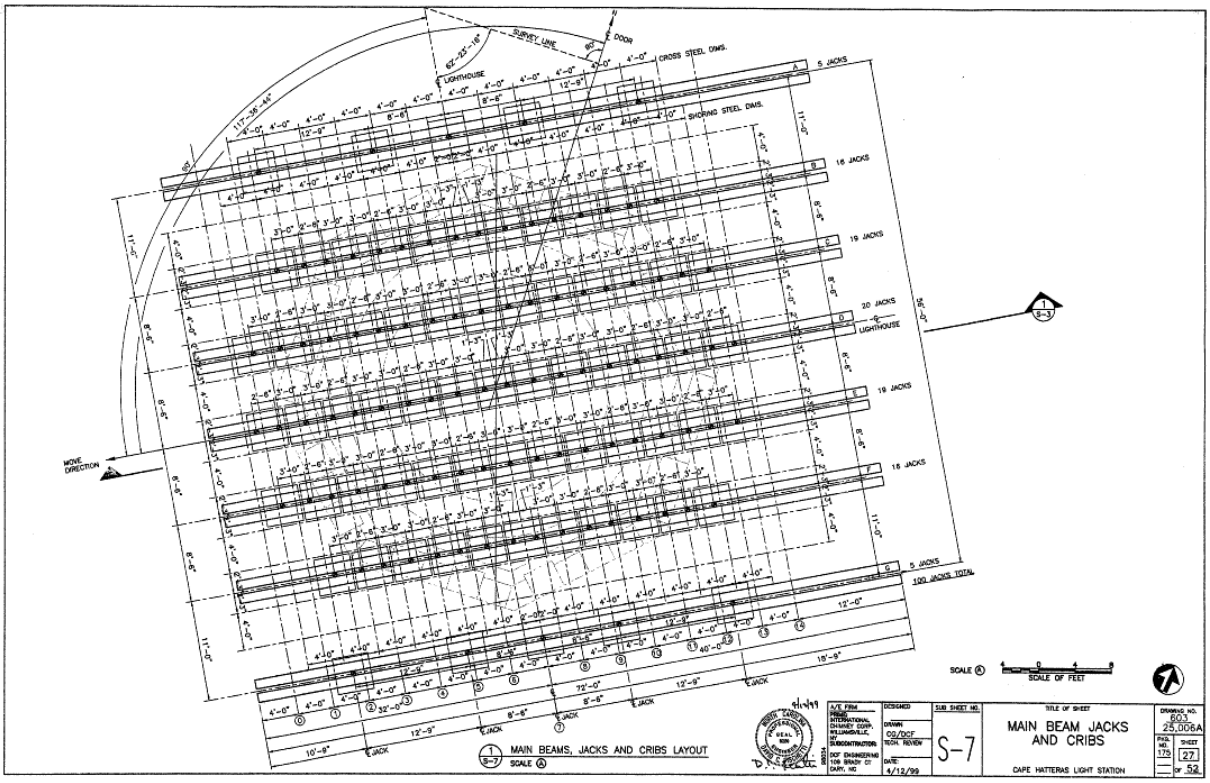


Figure 108. The design for installation of the main beam jacks and cribs. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

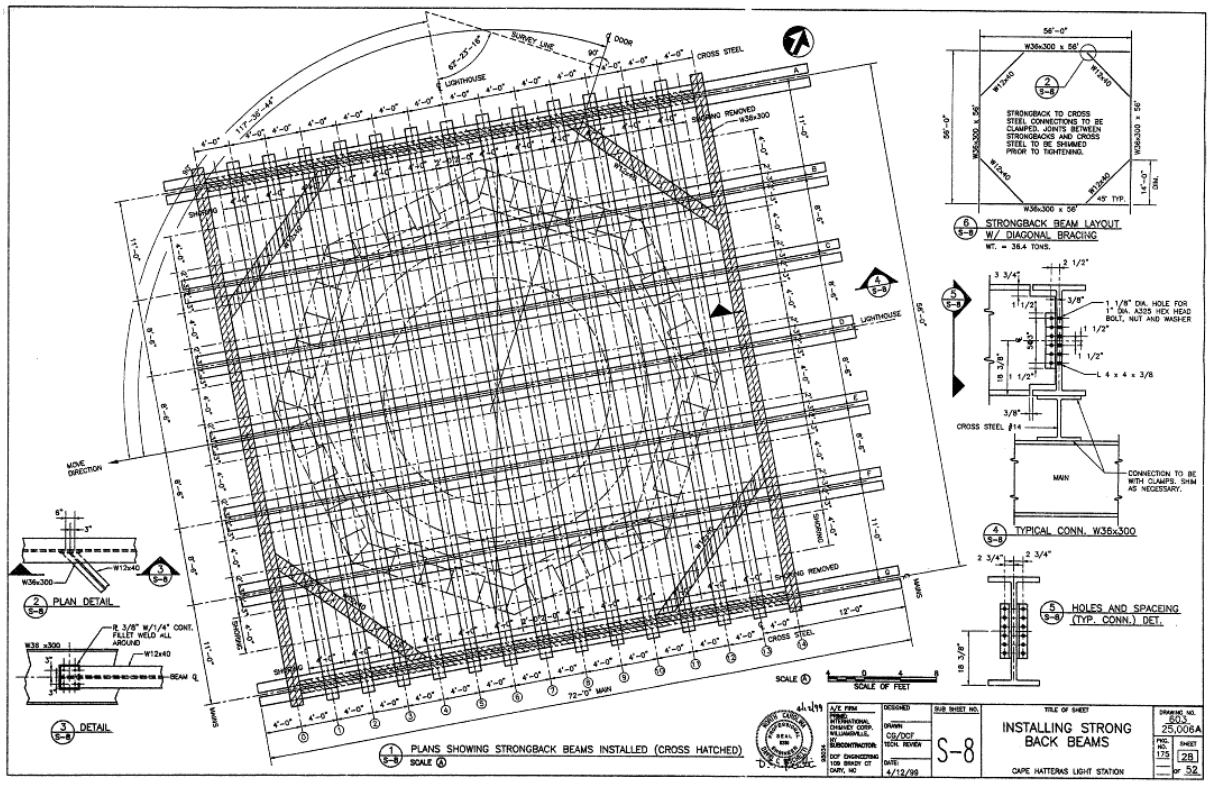


Figure 109. The design for installation of the strong back beams. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

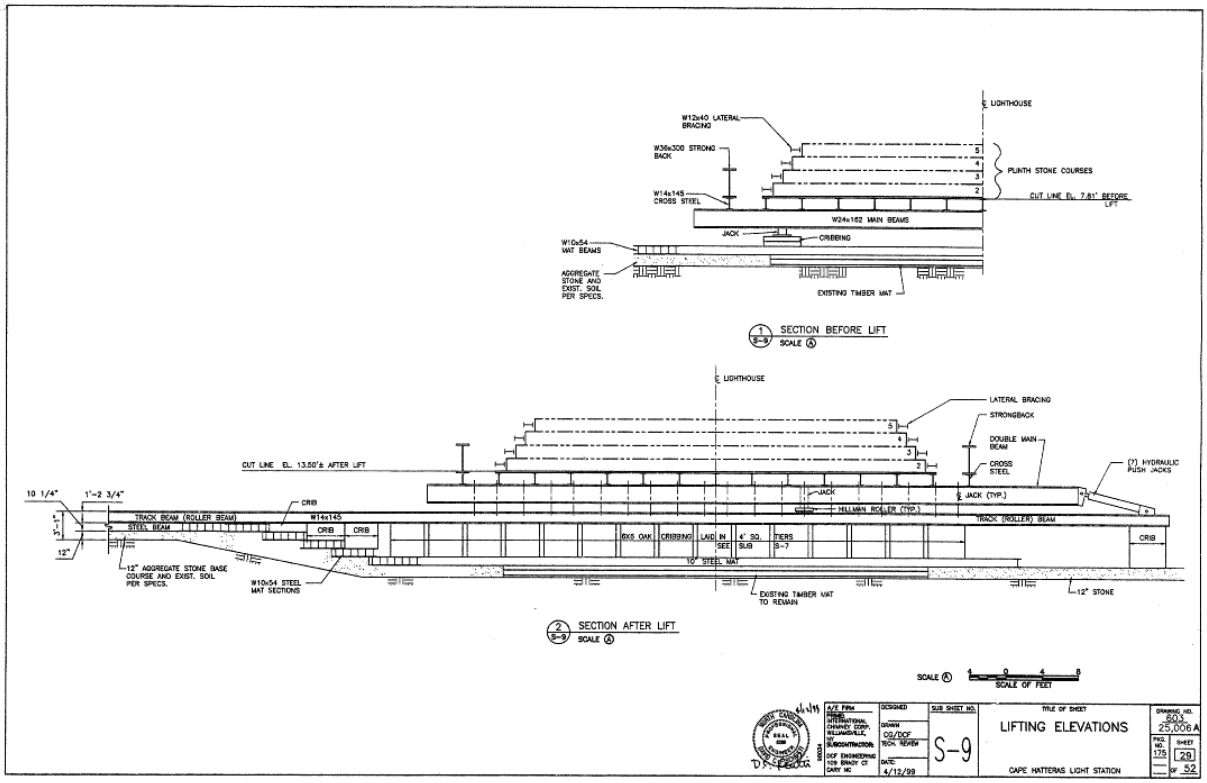


Figure 110. The design for lifting the lighthouse. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

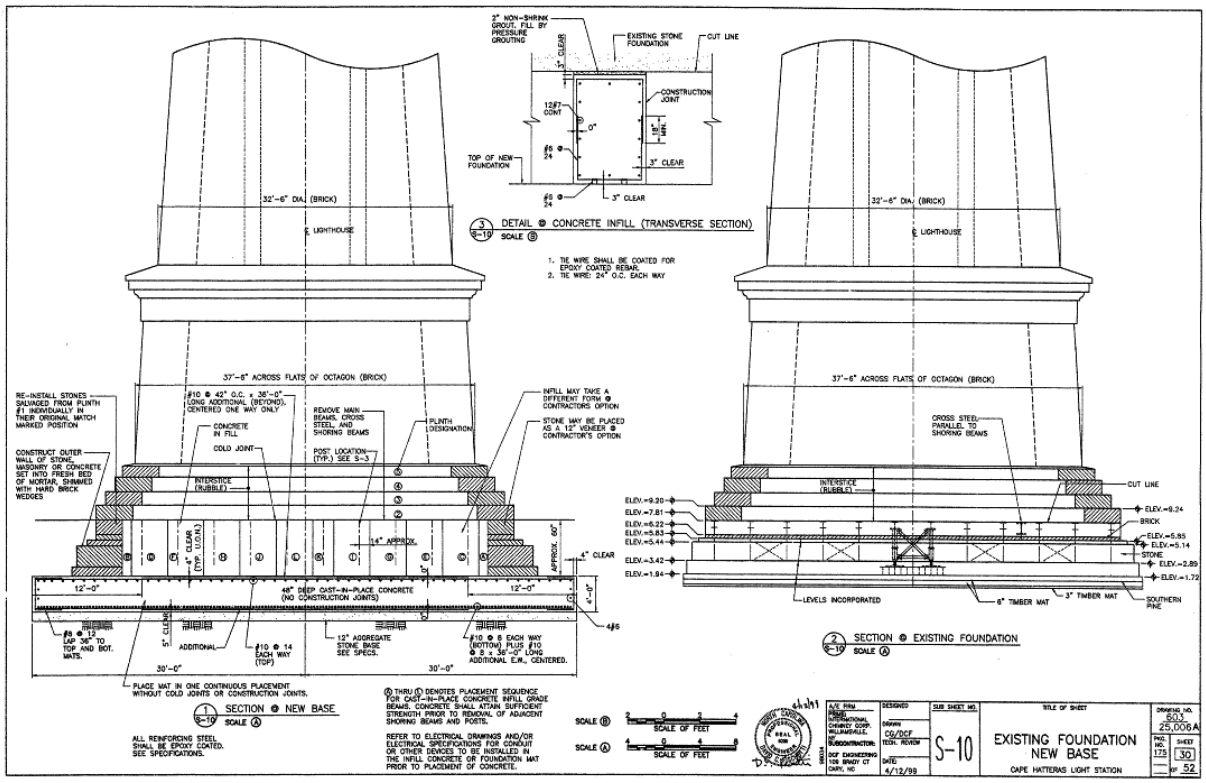


Figure 111. Sections through the existing foundation and new base. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

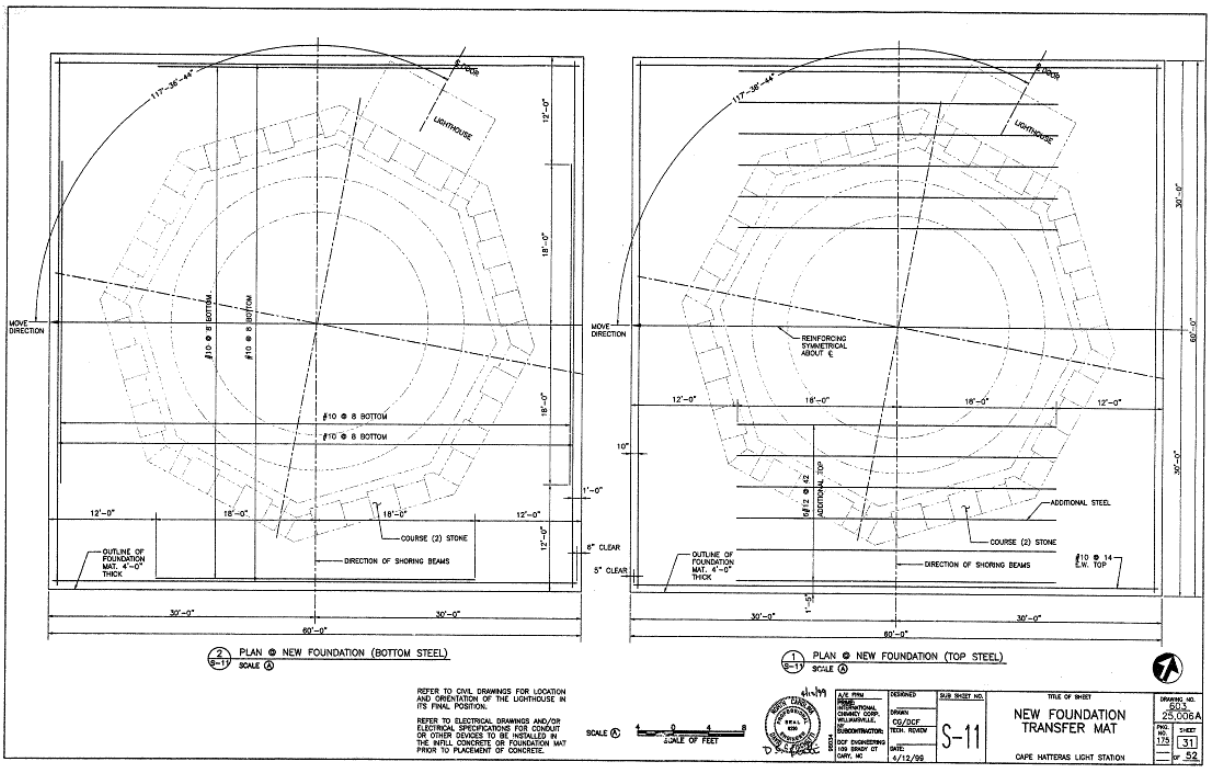


Figure 112. The plan of the new foundation (top and bottom). Drawing: NPS DSC eTIC No. CAHA 603 25006A.

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.[311]

ICC first arrived at Cape Hatteras on December 15, 1998 to begin preparations for moving the lighthouse.[312] 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. 113). The brick walkway was documented, marked, and removed in large sections (fig. 114). NPS archeologists were on site every day in order to monitor the proceedings, especially once excavation began (fig. 115). By late January, the entrance stairs and their foundation had been removed (fig. 116) and steel beams had been installed around the top four granite plinth rows (fig. 117). Meanwhile, sixty sensors were installed on the interior and exterior of the structure to monitor the lighthouse's stability and weather conditions; in addition, a plumb bob was hung down the center of the interior of the tower, where the clockworks once hung, just in case the sensors malfunctioned or ceased to work. In order to create a temporary roadway, or "move corridor,"

[311] NOAA HRD. "Chronological List of All Hurricanes which Affected the Continental United States: 1851-2005."
[312] 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.

trees were removed (fig. 118). 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 113. Excavation around the perimeter fence foundation. Photo: Cape Hatteras National Seashore Archives, 01/14/99.

Figure 114. Removal of the brick path in sections. Photo: Cape Hatteras National Seashore Archives, 01/13/99.

Figure 115 NPS employee Rob Bolling looks over found archeological items. Photo: Cape Hatteras National Seashore Archives, 01/03/99.

Figure 116. The front entrance stair has been removed. Photo: Cape Hatteras National Seashore Archives, 01/22/99.

Figure 117. 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 118. The move corridor is cleared. Photo: Cape Hatteras National Seashore Archives, 01/08/99.

In early February, the oil house was lifted (fig. 119), placed on a flatbed trailer, and transported down the move corridor to sit on temporary cribbing (fig. 120); 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. 121). 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. 122).

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. 123). On March 24, the Principal Keeper's Quarters was lifted and moved into place via a tractor trailer (fig. 124). The Double Keepers' Quarters followed along in the same manner two days later (fig. 125).

Figure 119. The oil house is lifted and supported by steel beams. Photo: Cape Hatteras National Seashore Archives, 02/04/99.

Figure 120. The oil house is transported to its new temporary site via flatbed trailer. Photo: Cape Hatteras National Seashore Archives, 02/05/99.

Figure 121. The cable saw cuts through a portion of the plinth stone. Photo: Cape Hatteras National Seashore Archives, 02/13/99.

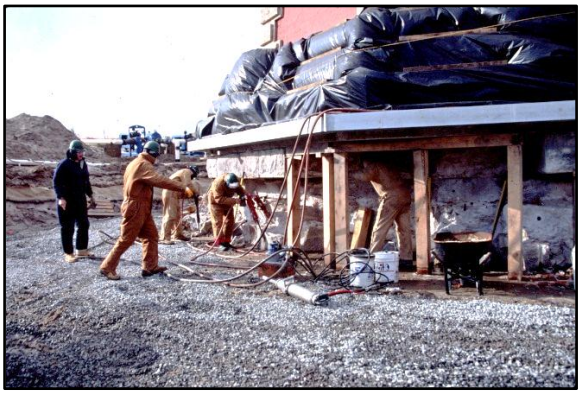


Figure 122. Workers chisel away at the granite rubble foundation. Photo: Cape Hatteras National Seashore Archives, 02/22/99.

Figure 123. The new foundation is poured for the Double Keepers' Quarters. Photo: Cape Hatteras National Seashore Archives, 03/18/99.

Figure 124. The Principal Keeper's Quarters is moved into placed (top) while the Double Keeper's Quarters waits. Photo: Cape Hatteras National Seashore Archives, 03/23/99.

Figure 125. The Double Keeper's 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. 126). Each shoring tower was composed of four steel posts with cross braces between for lateral support (fig. 127). Work progressed below the lighthouse in segments like this until the last column of granite was separated from the plinth above May 5 (fig. 128-29). 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. 130).

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. 131-132). 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. 133). The foundation would then eventually get backfilled, once the concrete had fully cured.

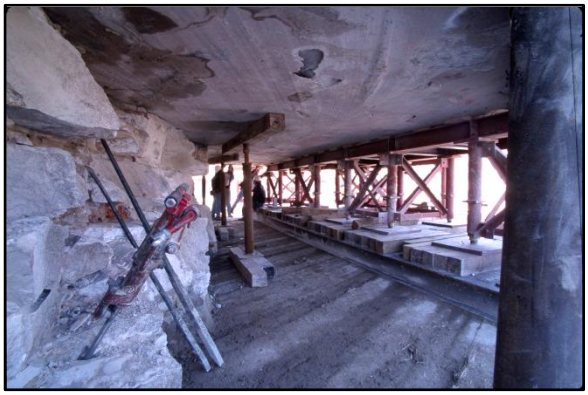


Figure 126. Workers continue to remove granite as steel shoring towers are installed behind them. Photo: Cape Hatteras National Seashore Archives, 03/18/99.

Figure 127. 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 128. Another row of shoring towers with steel beams above is installed under the tower. Photo: Cape Hatteras National Seashore Archives, 04/08/99.

Figure 129. The final column of granite foundation is separated from the granite plinth above. Photo: Cape Hatteras National Seashore Archives, 05/05/99.

Figure 130. The lighthouse fully supported by temporary shoring towers. Photo: Cape Hatteras National Seashore Archives, 05/06/99.

Figure 131. 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 132. Pouring 540 yards of marine-grade concrete into the formwork. Photo: Cape Hatteras National Seashore Archives, 05/01/99.

Figure 133. 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. 134-35). The "main beams" were installed on hydraulic jacks with rollers (figs. 136-37). 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. 138). 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. 139).

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. 140-41).

Figure 134. 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 135. All seven "main beams" installed. Photo: Cape Hatteras National Seashore Archives, 05/23/99.

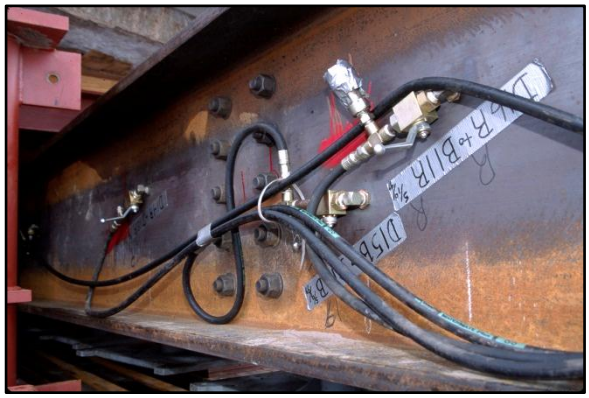


Figure 136. The "main beams" were equipped with hydraulic jacks. Shown here are some of the oil lines. Photo: Cape Hatteras National Seashore Archives, 05/14/99.

Figure 137. 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 138 above. Fifteen "cross beams" installed above and perpendicular to the "main beams." Photo: Cape Hatteras National Seashore Archives, 05/24/99.

Figure 139, right. "Strongback beams" surrounding the plinth, which tie the steel support structure together. Photo: Cape Hatteras National Seashore Archives, 05/31/99.

Figure 140. Cribbing installed under a "main beam" and some of its jacks. Photo: Cape Hatteras National Seashore Archives, 06/08/99.

Figure 141. 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. 142-43). One "main beam" section at a time, the wood cribbing was removed to slide a "roller beam" directly underneath, and parallel to, the "main beam" and jacks with rollers attached (fig. 144). Out from under the lighthouse, additional "roller beams" were installed to those already installed under the tower, to form a track (fig. 145). Five horizontal push jacks, hydraulically clamped between the "roller beams" and the corresponding "main beam" above, were then installed (fig. 146). Ivory soap was used to coat the tops of the "roller beams."

After decades of studies, debates, and planning, moving began on June 17. That day, the lighthouse moved 10'-6" (fig. 147).

Figure 142. The jacks in their lowered position. Photo: Cape Hatteras National Seashore Archives, 06/13/99.

Figure 143. The jacks in their upper, non-supporting position, in preparation for installation of "roller beam" and rollers. Photo: Cape Hatteras National Seashore Archives, 06/12/99.

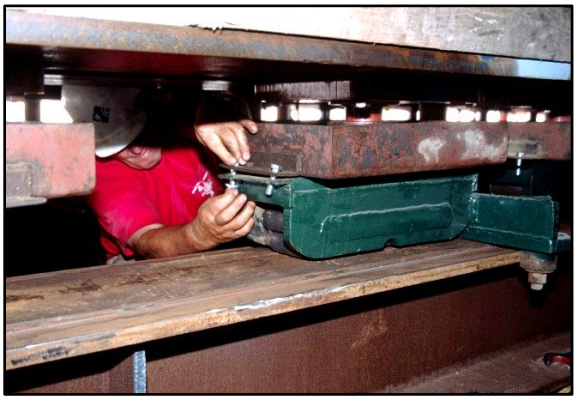


Figure 144. A roller beam has been installed under a "main beam." A roller is being attached to the underside of a jack. Photo: Cape Hatteras National Seashore Archives, 06/14/99.

Figure 145. "Roller beams" butted together to form a track. Photo: Cape Hatteras National Seashore Archives, 06/12/99.

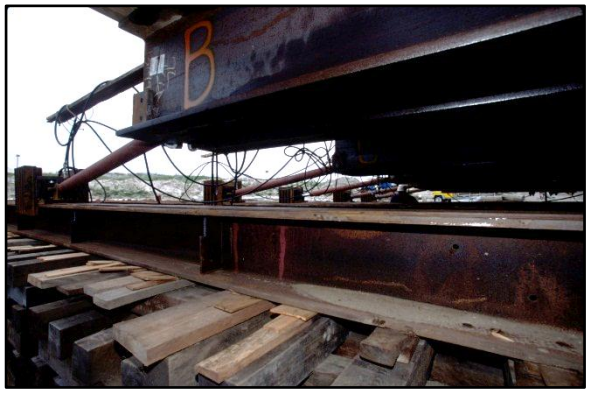


Figure 146. Push rams installed at the rear. Photo: Cape Hatteras National Seashore Archives, 06/18/99.

Figure 147. On the first day, the lighthouse moved 10′-6″. Photo: Cape Hatteras National Seashore Archives, 06/17/99.

The jacks could only push the lighthouse above 5’-0” at a time before they became fully extended (fig. 148). Once extended, they were removed, compressed, and reinstalled 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!

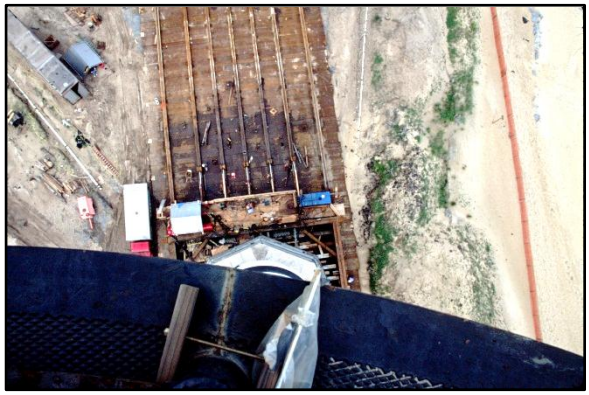


Figure 148. The extended push rams from above. Photo: Cape Hatteras National Seashore Archives, 06/21/99.

Figure 149. 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.

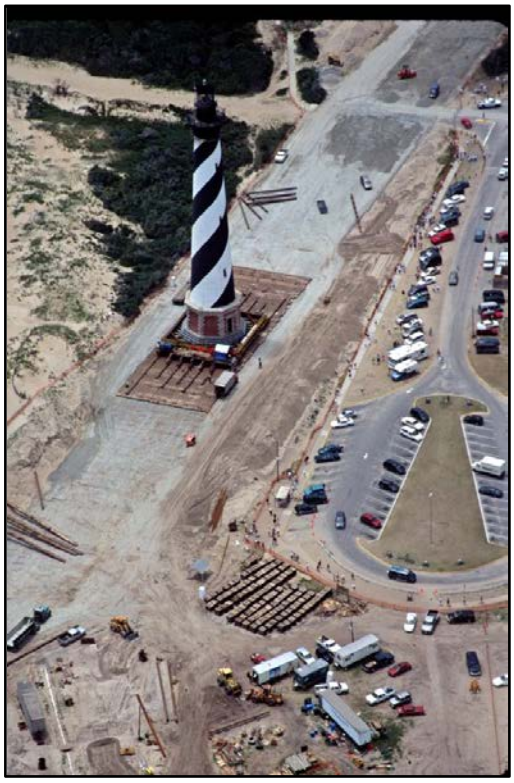


Figure 151, above. At the end of the day on June 25, the lighthouse had moved a total of 898'-0". Photo: Cape Hatteras National Seashore Archives, 6/25/99.

Figure 150, 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 152, above. On June 30, the lighthouse was over half way to its final destination. Photo: Cape Hatteras National Seashore Archives, 06/30/99.

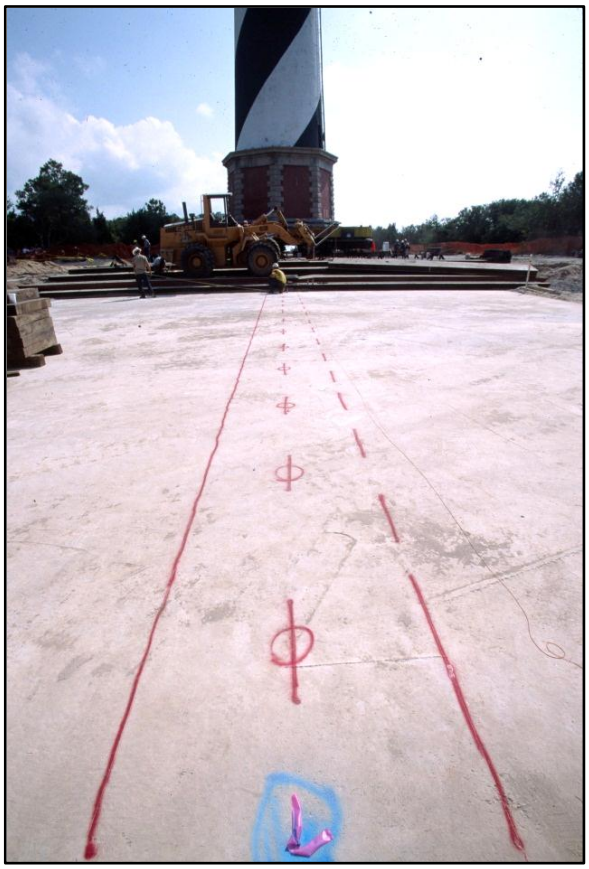


Figure 153, right. The blue circle on the new concrete mat foundation must be located directly below the center of the lighthouse. The bottom of the lighthouse has a similar blue circle. Photo: Cape Hatteras National Seashore Archives, 07/07/99.

Figure 154. Roller beams being placed above the concrete mat foundation. Photo: Cape Hatteras National Seashore Archives, 07/08/99.

Figure 155. 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 "roller 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. 156). Once all the "roller beams" were removed and the jacks were sitting directly on the cribbing, the unified jacking system lowered the lighthouse down 5'-5-½ " to its original elevation. Then "strong back beams" were removed (fig. 157). As the "cross beams" and "main beams" were removed, the steel shoring towers with beams above were reinstalled under the tower (fig. 158). In late July, masons began laying a center spine and ribs of brick masonry around the shoring towers (fig. 159). 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. 160-61). The new brick foundation was completed on September 14 (fig. 162).

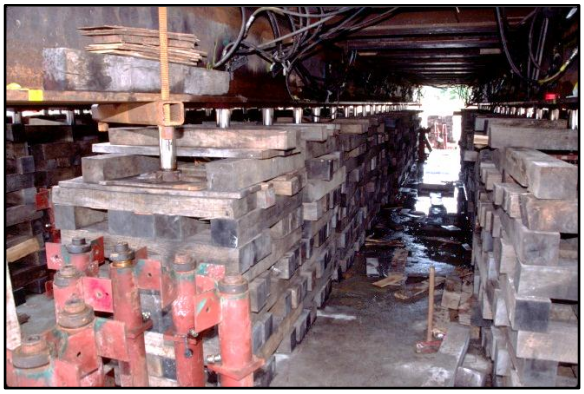


Figure 156. The jacks resting on wood cribbing once again. Photo: Cape Hatteras National Seashore Archives, 07/16/99.

Figure 157 The "strongback beams" being removed. Photo: Cape Hatteras National Seashore Archives, 07/25/99.

Figure 158. The shoring towers back under and supporting the lighthouse. Photo: Cape Hatteras National Seashore Archives, 07/26/99.

Figure 159. The installation of the brick masonry foundation begins. Photo: Cape Hatteras National Seashore Archives, 07/28/99.

Figure 161, 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 160, 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 162. The last section of shoring towers to be removed and replaced with brick masonry. Photo: Cape Hatteras National Seashore Archives, 09/09/99.

Figure 163. 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. 164). The lowest level of plinth blocks, which were originally whole granite blocks, were cut and veneered onto the brick foundation (fig. 165). Once installed, this course was also backfilled. The front stair was then reinstalled (fig. 166). Finally, after all site work was completed, the lighthouse was re-lit in a ceremony the night of November 13, 1999 (fig. 167).

Figure 164. Metal beams around the plinth are removed. Photo: Cape Hatteras National Seashore Archives, 09/27/99.

Figure 165. The bottom plinth row reinstalled as a veneer. Photo: Cape Hatteras National Seashore Archives, 09/29/99.

Figure 166. The front stair is reinstalled. Photo: Cape Hatteras National Seashore Archives, 10/14/99

Figure 167. The relighting ceremony. Photo: Cape Hatteras National Seashore Archives, 11/13/99.

The final cost for relocating the Cape Hatteras Light Station included $480,000 for the new foundation, $20,000 for the new lightning protection system, and $9,013,200 for design and move services, demolition of the old foundations, installation of a temporary public viewing area and electrical service.[313]

In 1999, the American Society of Civil Engineers designated the Cape Hatteras Lighthouse a Historic Civil Engineering Landmark. In addition, ICC received the Outstanding Civil Engineering Achievement award from the American Society of Civil Engineering, and the Grand Award from the American Consulting Engineers Council for excellence in engineering design. In 2000, Expert House Movers received the OPAL award from the American Society of Civil Engineers.[314]

In November 1999, the design drawings were updated to include as-built conditions (fig. 168).[315]

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.[316] Afterwards, the lighthouse was reopened to the public for climbing.

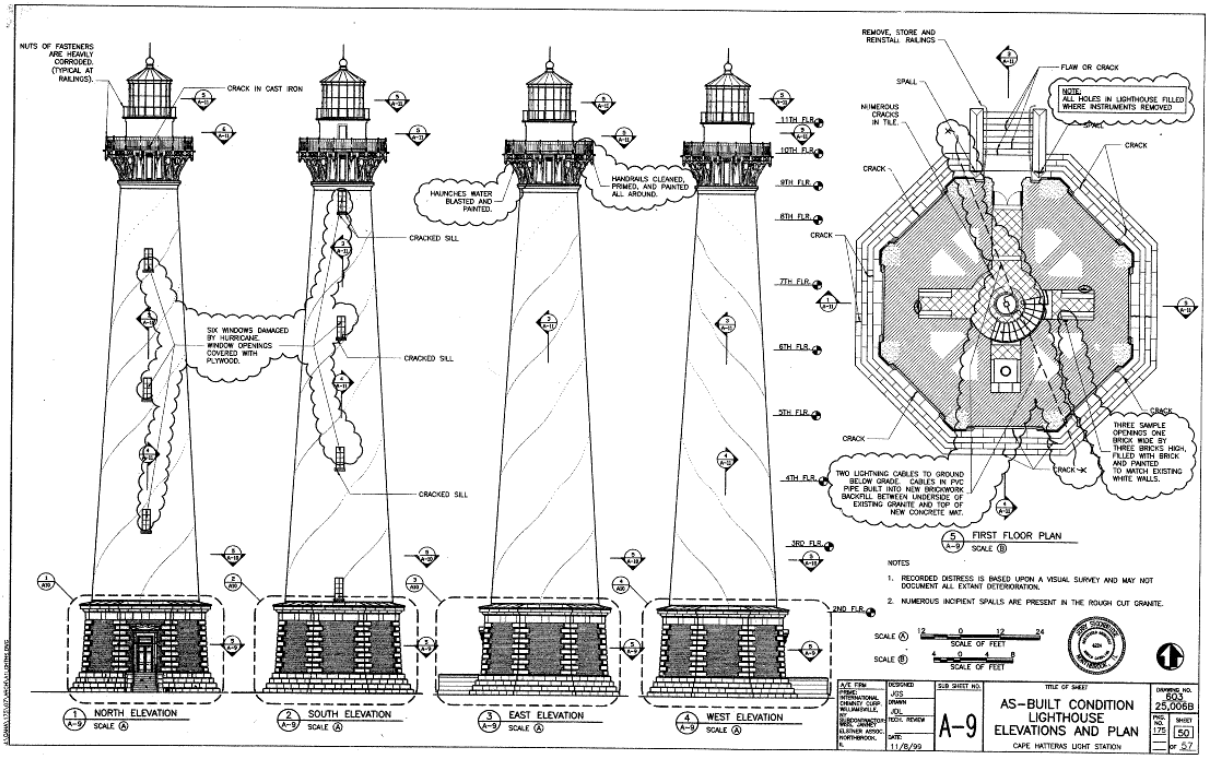


Figure 168. As-built drawings of the elevations and first-floor plan, dated November 1999, showing the only changes to the design for the lighthouse. Drawing: NPS DSC eTIC No. CAHA 603 2500B.

[313] 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.
[314] NPS, "Cape Hatteras Light Station CLR," p. 32.
[315] Denver Service Center, National Park Service. "Relocate the Cape Hatteras Light Station." *Project Record Drawings.* November 8, 1998. NPS DSC eTIC No. CAHA 603 25006.
[316] Denver Service Center, National Park Service. "Lighthouse Move Phase II." *As-Constructed Drawings.* December2000. NPS DSC eTIC No. CAHA 603 41024C.

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.[317]

On June 11, 2001, the lighthouse was closed to make needed repairs to the interior metal spiral stairs. It would stay closed until 2003.[318]

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.[319]

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:

[317] Cape Hatteras National Seashore Archives, Manteo, NC, CAHA 5515: CAHA Compliance – Cape Hatteras Lighthouse Safety Fence Donation, 2001.
[318] NPS, "Cape Hatteras Light Station," *Website*.
[319] 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.[320]

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.[321]

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.[322] In December, the lighthouse was painted.[323] After all work was completed, the lighthouse was reopened on April 18, 2003.[324] 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.[325] In March, the men removed the remaining lens components from the National Seashore museum storage facility to the Graveyard of the Atlantic Museum.[326] 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.[327] In early 2006, the removal of the pedestal was deemed an adverse effect to the

[320] 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.

[321] 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.

[322] 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.)

[323] NPS, "Cape Hatteras Light Station," *Website*.

[324] Ibid.

[325] 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.

[326] 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.

[327] 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.[328] 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.[329]

In 2006, the lens pedestal and clockwork were removed from the lighthouse and reunited with the lens at the Museum (fig. 170).[330]

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.[331]

In 2014, Joseph K. Opperman—Architect, P.A. and Bennett Preservation Engineering PC completed *Cape Hatteras Lighthouse Condition Assessment Report.*[332] This report will be further discussed in the following physical description, condition assessment, and recommended treatment sections.

[328] 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.
[329] 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.
[330] NPS, "Cape Hatteras Light Station," *Website*.
[331] Ibid.
[332] 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 Confederates
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 moved (Feb & Mar)
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.	

1

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.

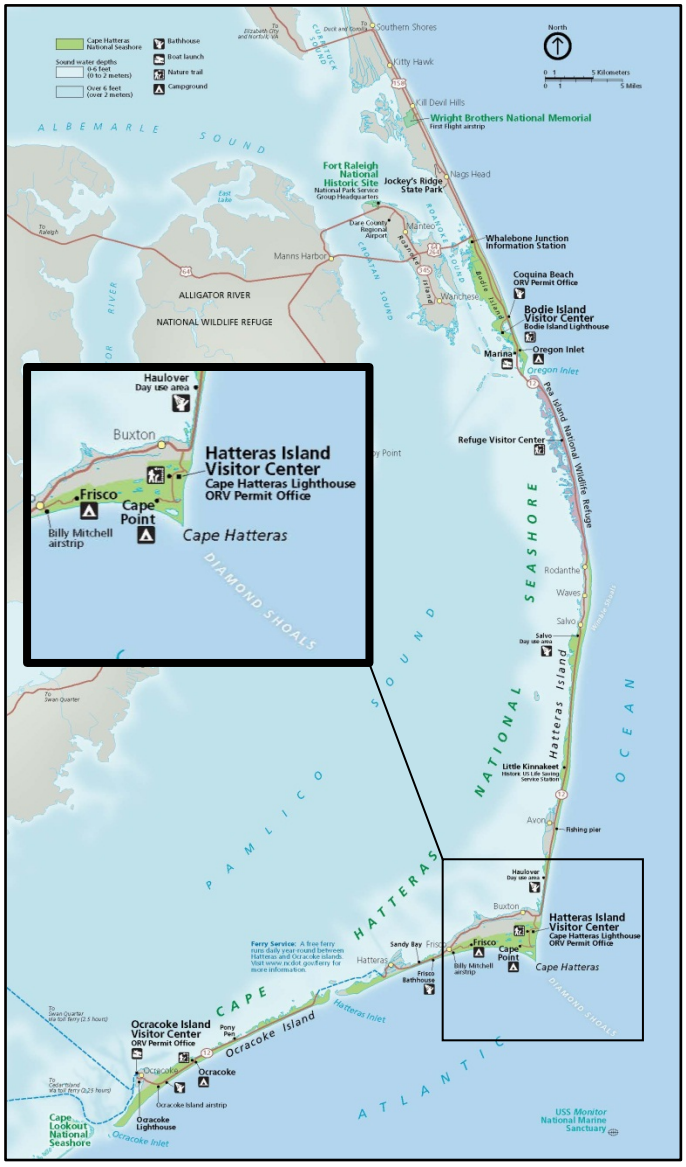


Figure 171. Cape Hatteras National Seashore is located on the Outer Banks of North Carolina. Inset: Cape Hatteras Lighthouse is located on Hatteras Island. Map: Harpers Ferry Center, 2008.

Hatteras Island, one of the barrier islands, is located about halfway between the northern and southern reaches of the park (fig. 171 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.

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 2,500'-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).

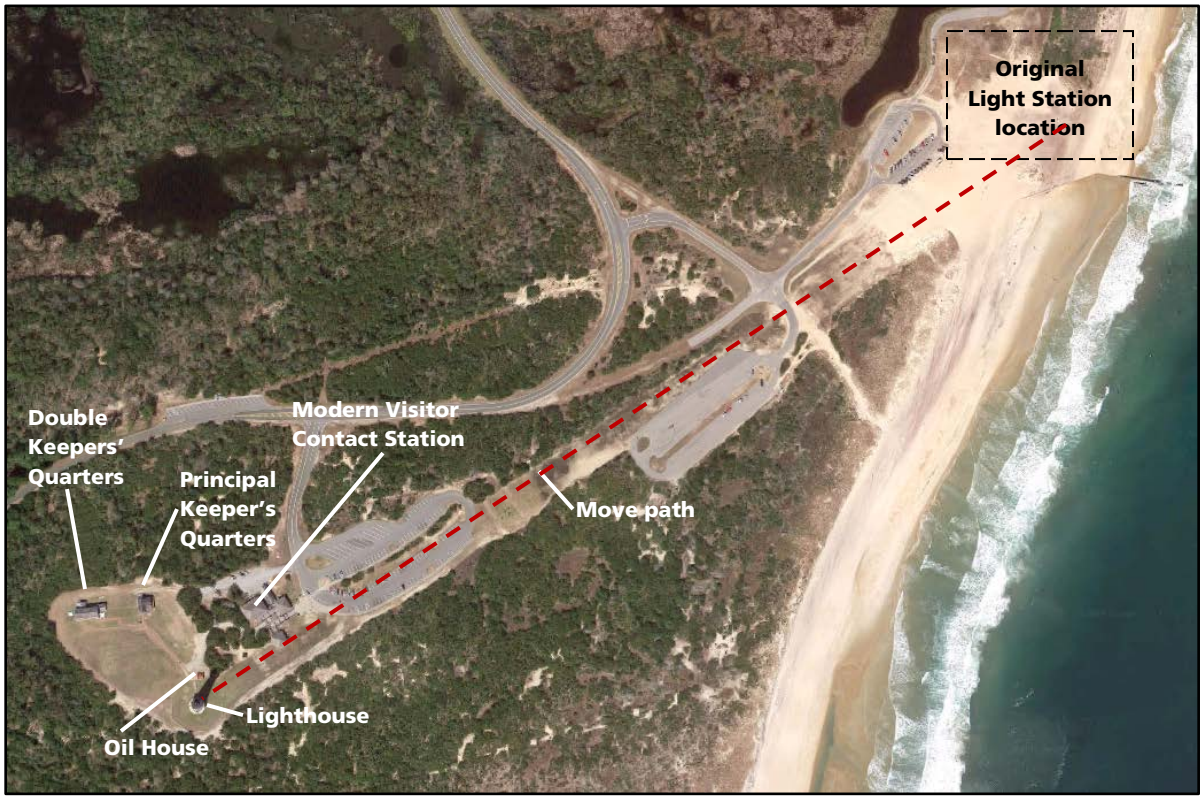


Figure 172. A Google Earth aerial view of the light station. The new location is at the bottom left, the original location is at the top right, and the move path joins the two sites. Photo: Google ©, 2015.

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.

Figure 173. Cape Hatteras Lighthouse. Photo: HPTC, 06/18/15.

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).

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.

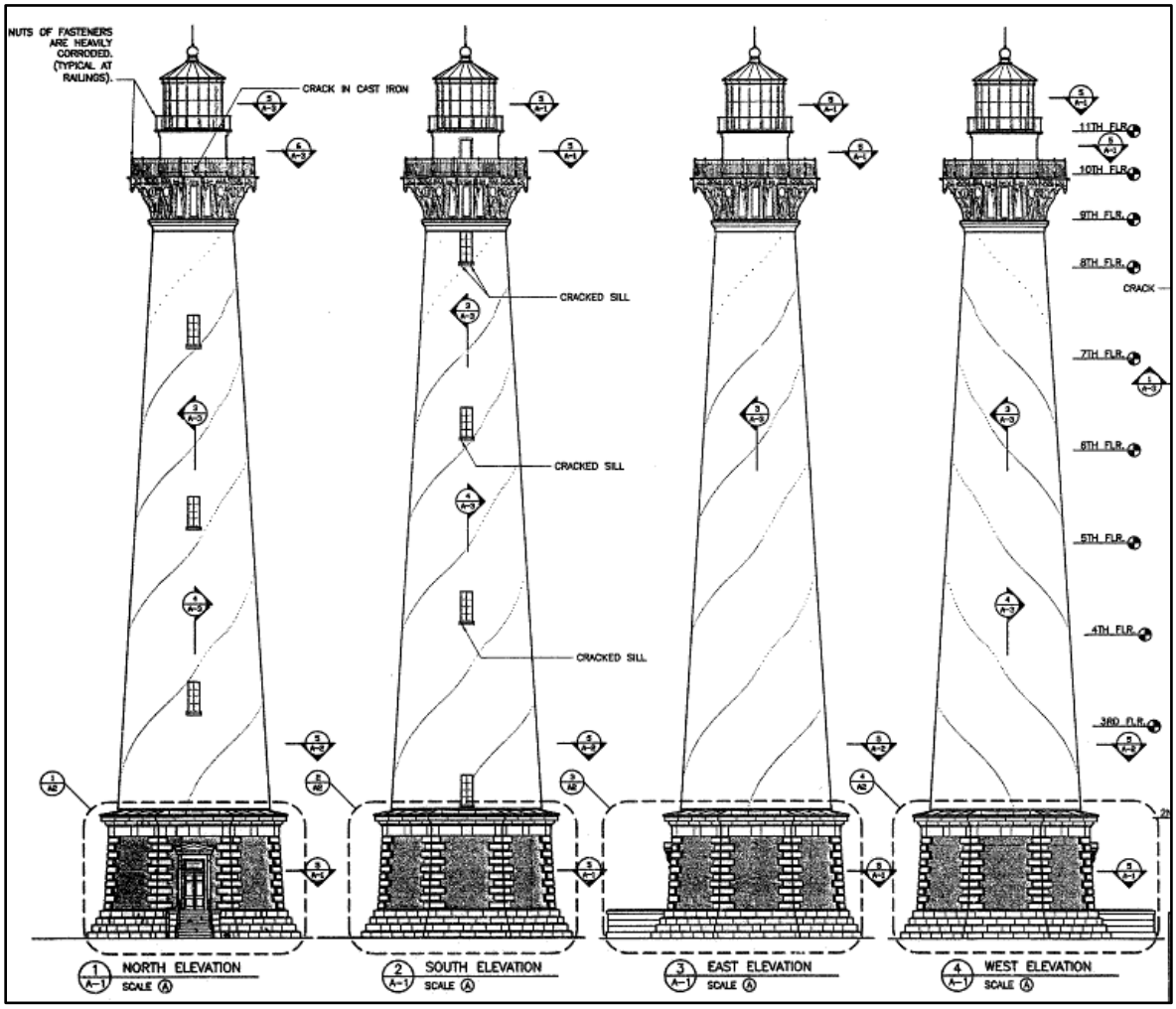


Figure 174. From left to right, the north elevation, south elevation, east elevation, and west elevation. Drawing: NPS DSC eTIC No. CAHA 603 25006A. Cropped by author.

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.

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).

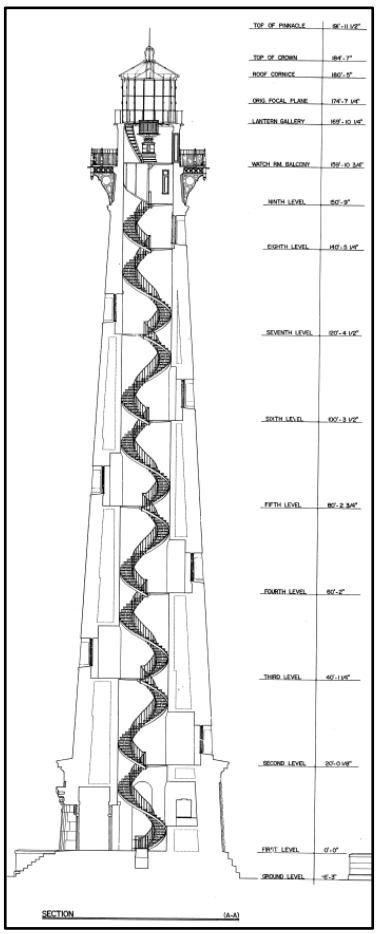


Figure 175. Section through the lighthouse showing the organization of the interior into separate balcony floor levels joined by a central vertical circulation shaft. See fig. 6 for cut line. Drawing: HABS, 1989. Cropped by author.

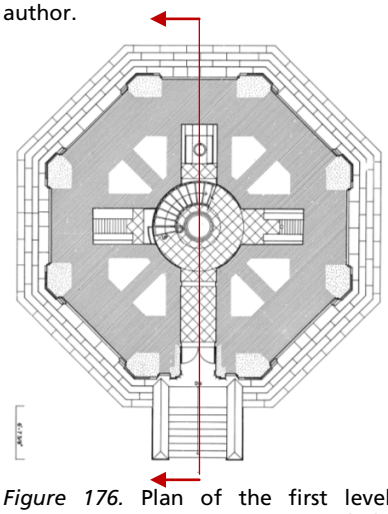


Figure 176. Plan of the first level. Drawing: HABS, 1989. Cropped by author.

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 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).

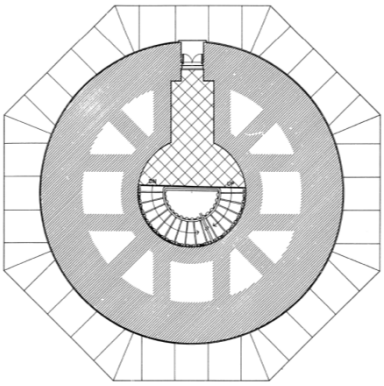


Figure 177. Plan of the second level. Drawing: HABS, 1989. Cropped by author.

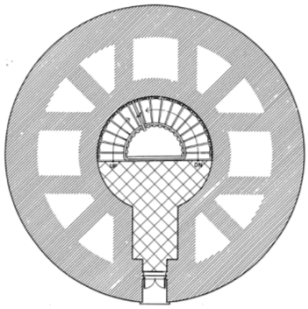


Figure 178. Plan of the third level. Drawing: HABS, 1989. Cropped by author.

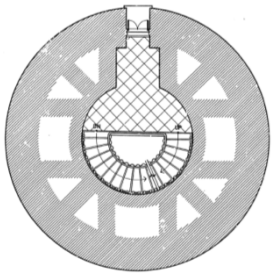


Figure 179. Plan of the fourth level. Drawing: HABS, 1989. Cropped by author.

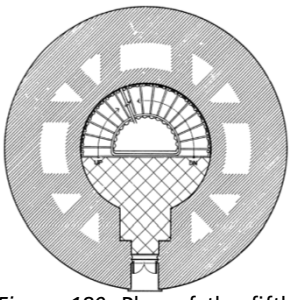


Figure 180. Plan of the fifth level. Drawing: HABS, 1989. Cropped by author.

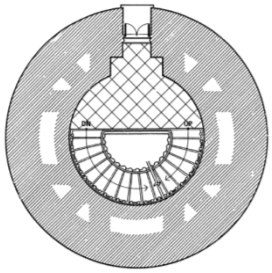


Figure 181. Plan of the sixth level. Drawing: HABS, 1989. Cropped by author.

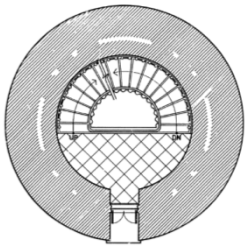


Figure 182. Plan of the seventh level. Drawing: HABS, 1989. Cropped by author.

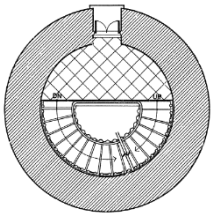


Figure 183. Plan of the eighth level. Drawing: HABS, 1989. Cropped by author.

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. 13). 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. 14). 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. 15). 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. 16); 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.

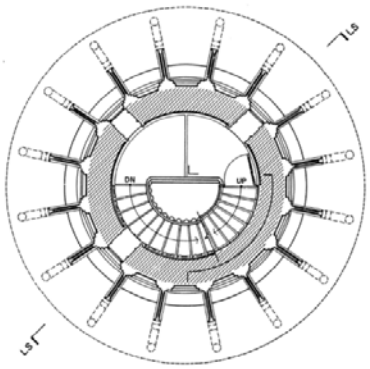


Figure 184. Plan of the ninth (Service Room) level. Drawing: HABS, 1989. Cropped by author.

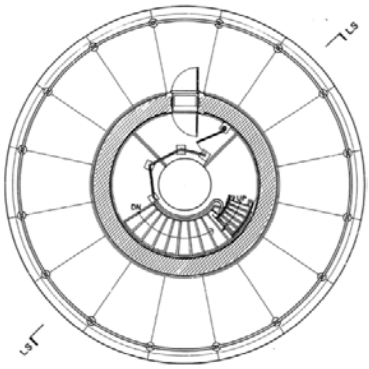


Figure 185. Plan of the tenth (Watch Room & Ext. Gallery) level. Drawing: HABS, 1989. Cropped by author.

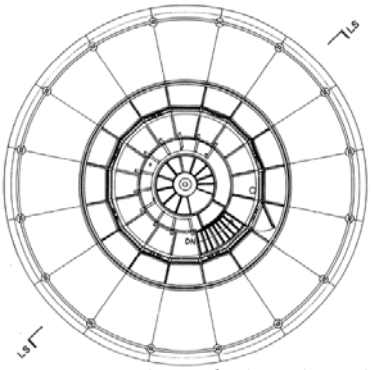


Figure 186. Plan of the eleventh (Lantern) level. Drawing: HABS, 1989. Cropped by author.

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.[1] 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.[2]

Prior to the move, the foundation was sliced just above the lowest course of plinth. Everything below this was removed. Everything above was retained and moved with the lighthouse.

[1] 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.

[2] "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.
>
> 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.[3]

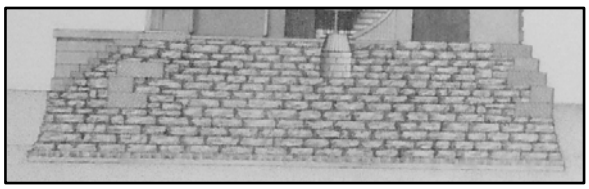


Figure 189. Atop the wood grillage (bottom layer as drawn) granite rubble masonry was laid. Above grade, the foundation was finished with five courses of a dressed granite plinth. Drawing: "Specifications," Plate No. 1. Cropped by author.

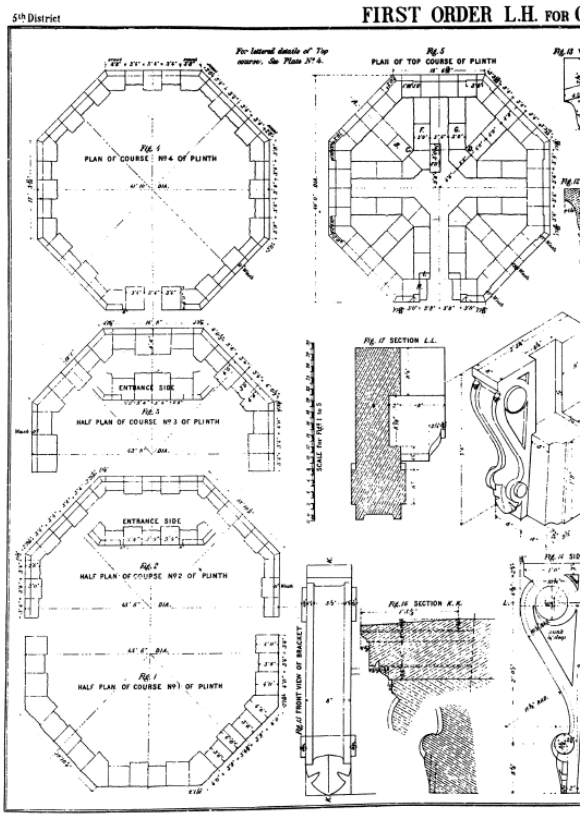


Figure 190, left. Plans of the granite plinth courses. Drawing: "Specifications," Plate No. 3. Cropped by author.

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

[3] "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 sold 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 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 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 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).[4]

All of the floor deck components are painted (the metal is red, the brick is white).

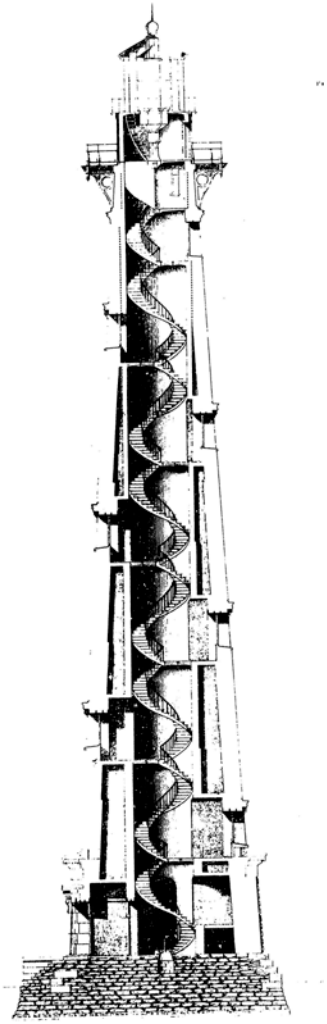


Figure 196. The vertical space of the lighthouse is divided by floor decks which alternate from occupying the north half and the south half of the core. Drawing: "Specifications," Plate No. 7. Cropped by author.

[4] "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.[5] 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. 205). Two parallel cast iron beams span the deck (east-west) through the center of the space approximately 2'-3" apart (figs. 203-4). The beams measure 1'-0" deep, 0'-4" wide, and at least 13'-0" long.[6] 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.[7]

All of the metal components are painted.

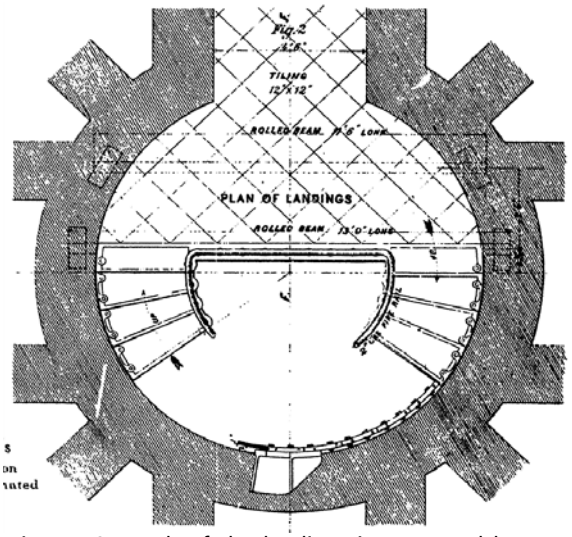


Figure 197. Each of the landings is supported by two I-beams. One is located along the edge of the landing; the other is located at the halfway point. Drawing: "Specifications," Plate No. 7. Cropped by author.

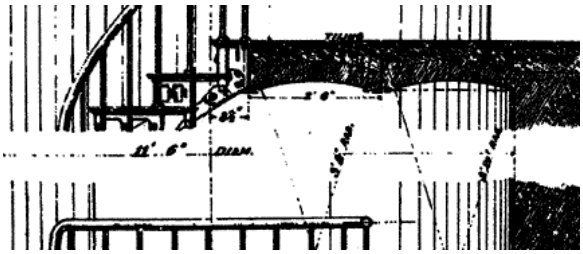


Figure 198. Brick arches are located between the iron I-beams. Concrete was poured atop the brick to make a flat surface for the finish tile. Drawing: "Specifications," Plate No. 7. Cropped by author.

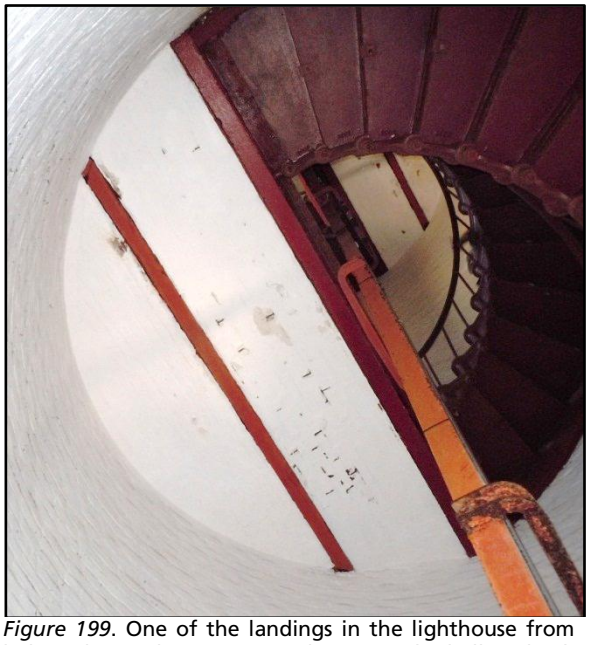


Figure 199. One of the landings in the lighthouse from below shows the two iron I-beams with shallow brick arches between. Photo: HPTC, 06/17/15.

[5] "Specifications," Plate No. 10 and pp. 20-23.
[6] Ibid.
[7] HHA/WJE. "Comprehensive Structural Analysis Report." p. 88.

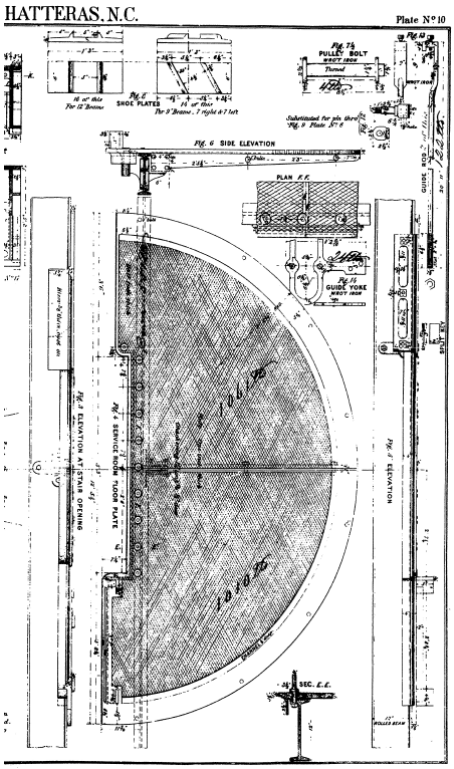


Figure 200. The original specification drawings for the ninth-level (Service Room) floor deck. Drawing: "Specifications," Plate No. 10. Cropped by author.

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.

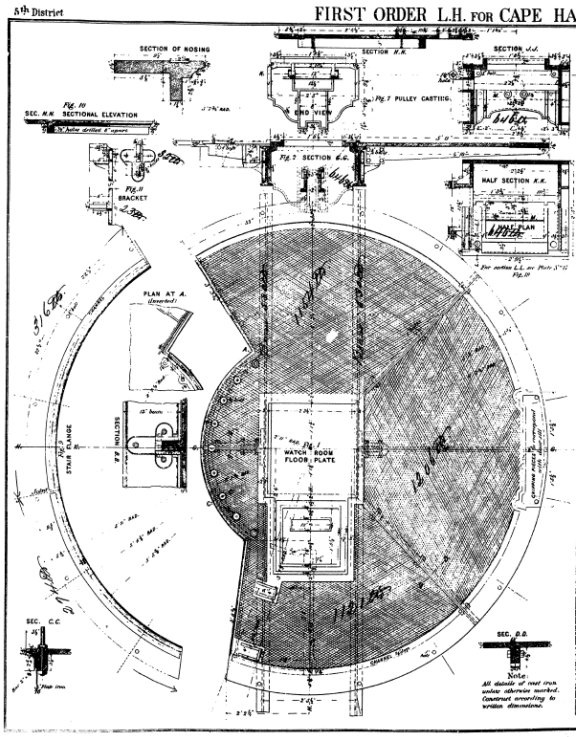


Figure 203, right. The original specification drawings for the tenth-level (Watch Room) floor deck. Drawing: "Specifications," Plate No. 10. Cropped by author.

1

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.

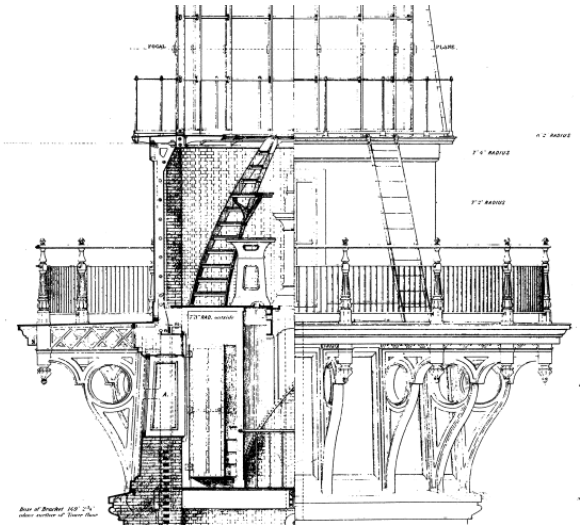
B101004	Balcony Construction

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].[8]

[8] HHA/WJE. "Comprehensive Structural Analysis Report." p. 102.



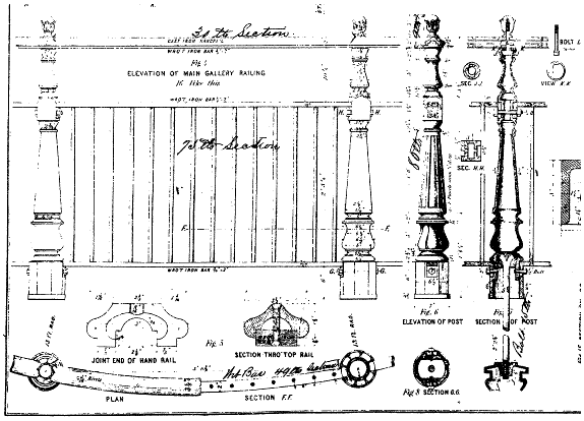


Figure 206, above An elevation/section drawing at the Service Room and Watch Room and Gallery detailing how the components fit together. Drawing: "Specifications," Plate No. 12. Cropped by author.

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.[9]

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.

[9] 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.

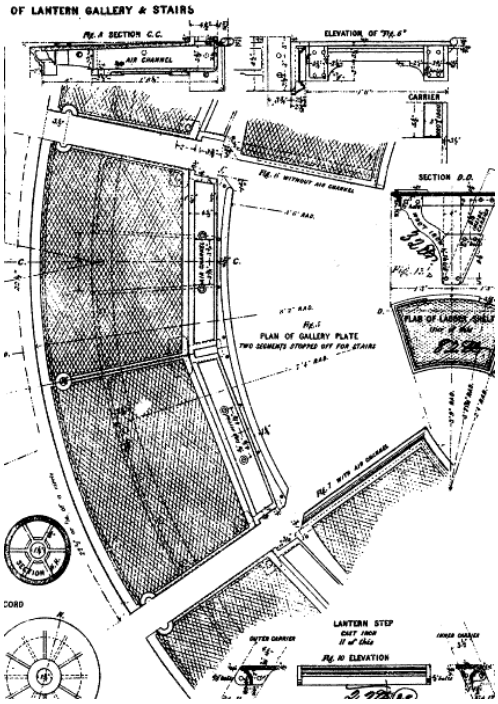


Figure 211. Plan of the lantern gallery plates at the interior ladder. Drawing: "Specifications," Plate No. 16. Cropped by author.

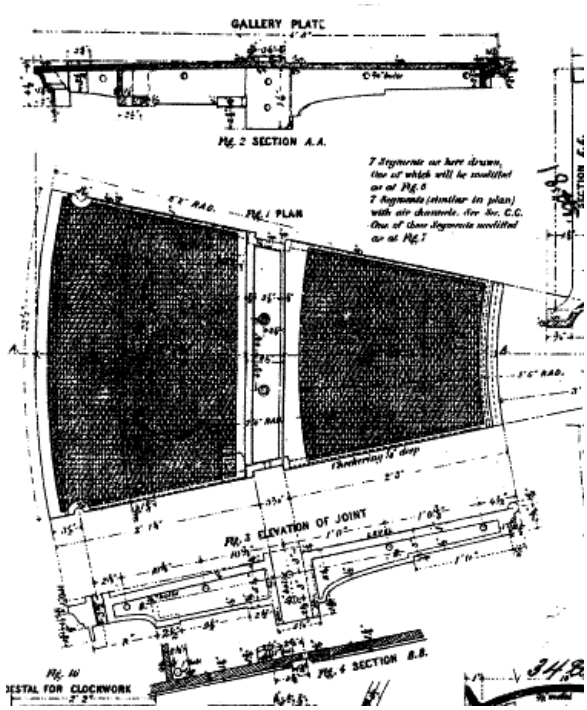


Figure 212. The original drawing of one of the sixteen lantern balcony plates. Drawing: "Specifications," Plate No. 16. Cropped by author.

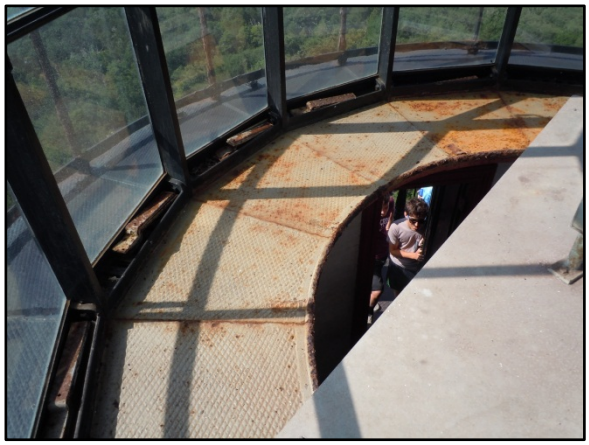


Figure 213. The glass lantern exterior wall separates the interior portion from the exterior. Photo: HPTC, 06/16/15.

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."[10] 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.

[10] HHA/WJE. "Comprehensive Structural Analysis Report." p. 133.

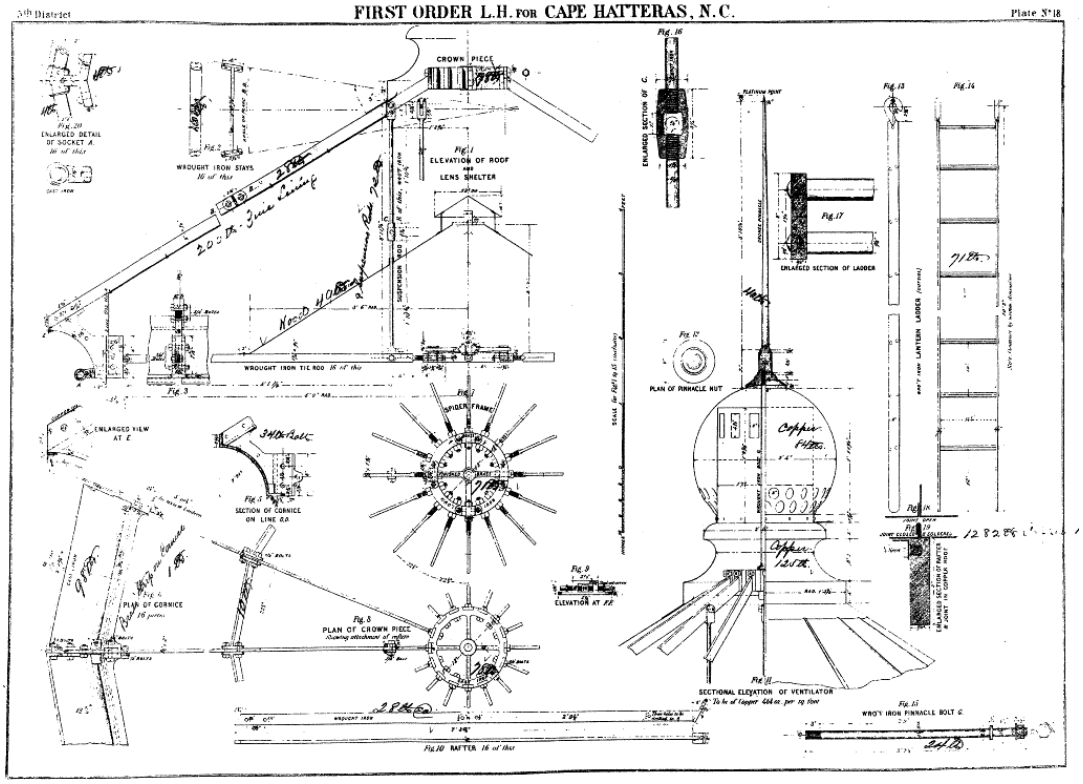


Figure 217. Original specification drawings showing how the roof framing structure works. Drawings: "Specifications," Plate No. 18..

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.[11]

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.[12]

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:

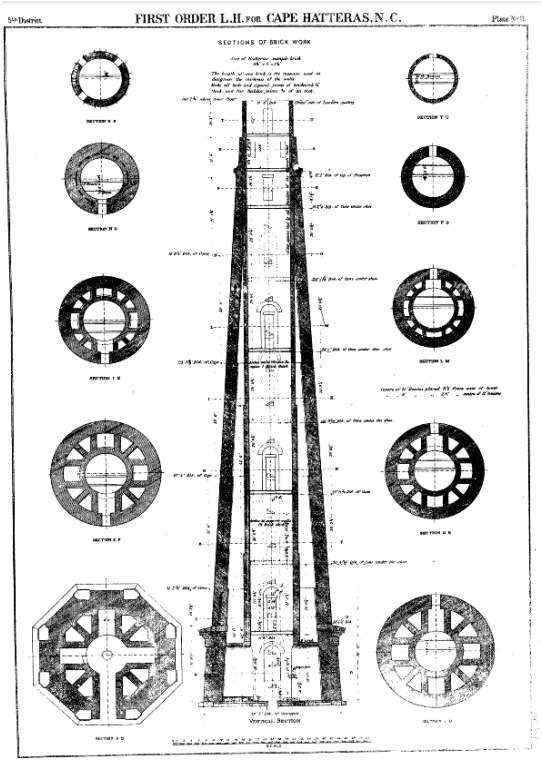


Figure 219. A section through the center of the tower and plans of each level (two through ten) show how the double exterior wall is constructed. Drawing: "Specifications," Plate No. 2.

Figure 220. Above the granite plinth, the octagonal, painted brick base has granite quoins and a granite cornice. Photo: HPTC, 06/17/15.

[11] "Specifications," pp. 14-15.
[12] 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.[13]

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.

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.

[13] 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'-5-1/2" just above the base's granite entablature and an exterior diameter of 16'-10-1/2" 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'-10-3/4" (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. 225). 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'-0-1/2" 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]."[14] 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.[15]

A door is also integrated into the exterior wall of the lantern; this feature may not be original.

[14] JKO/BPE, "Cape Hatteras Lighthouse," p. 12.
[15] 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 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 227, left. The exterior wall at the tenth level (Watch Room) is covered with metal panels. 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.

Figure 229, left. The interior of the Lantern with glass wall system. Photo: HPTC, 06/17/15.

B2020	Exterior Windows

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."[16] 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.[17]

Figure 231. Three tower windows are vertically stacked on the north elevation. Photo: HPTC, 06/17/15.

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."[18] See figs. 236-237.

Figure 232. Four tower windows are vertically stacked on the south elevation. Photo: HPTC, 06/17/15.

[16] JKO/BPE, "Cape Hatteras Lighthouse," pp. 10-11.
[17] HHA/WJE. "Comprehensive Structural Analysis Report." pp. 78-82.
[18] HHA/WJE. "Comprehensive Structural Analysis Report." pp. 78-82.

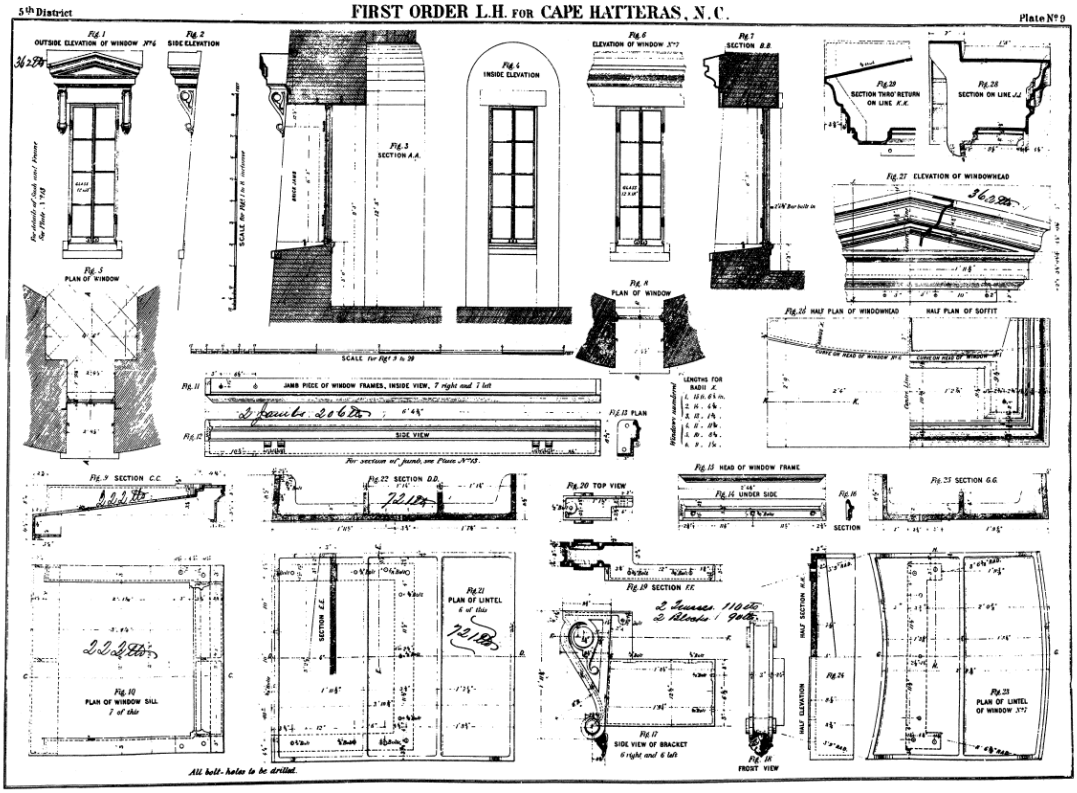


Figure 233. The original specifications drawings for the tower window (levels two through eight). Drawing: "Specifications," Plate No. 9.

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.

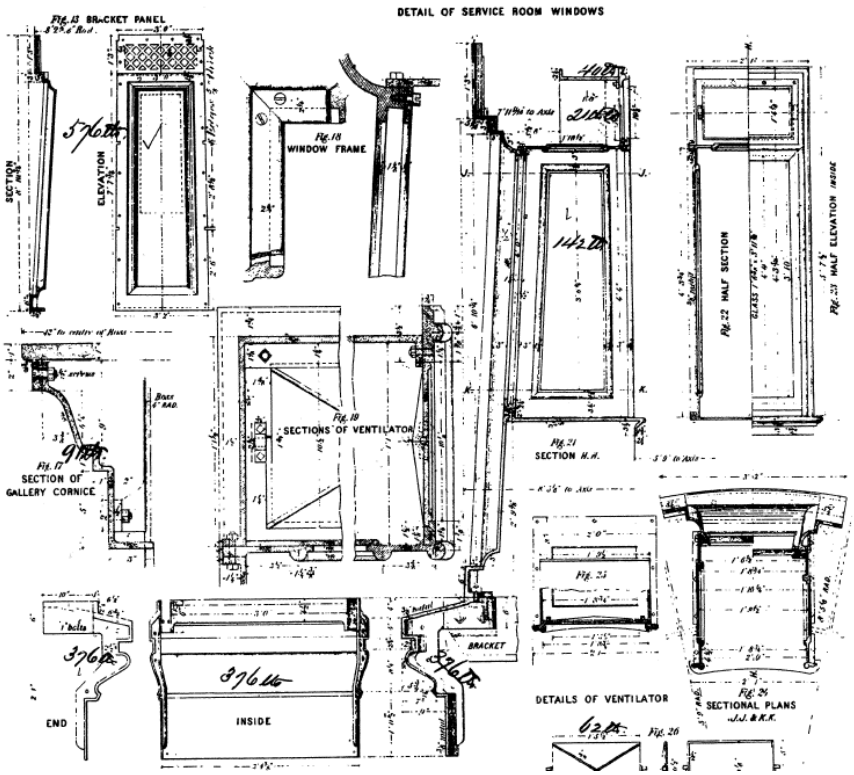


Figure 237. Original specification drawings for the Service Room windows. Drawing: "Specifications," Plate No. 15. Cropped by author.

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.[19]

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.[20] The current location of the doors and transom is unknown.

[19] HHA/WJE. "Comprehensive Structural Analysis Report." pp. 83-84.
JKO/BPE, "Cape Hatteras Lighthouse," p. 10.
[20] HHA/WJE. "Comprehensive Structural Analysis Report." pp. 83-84.

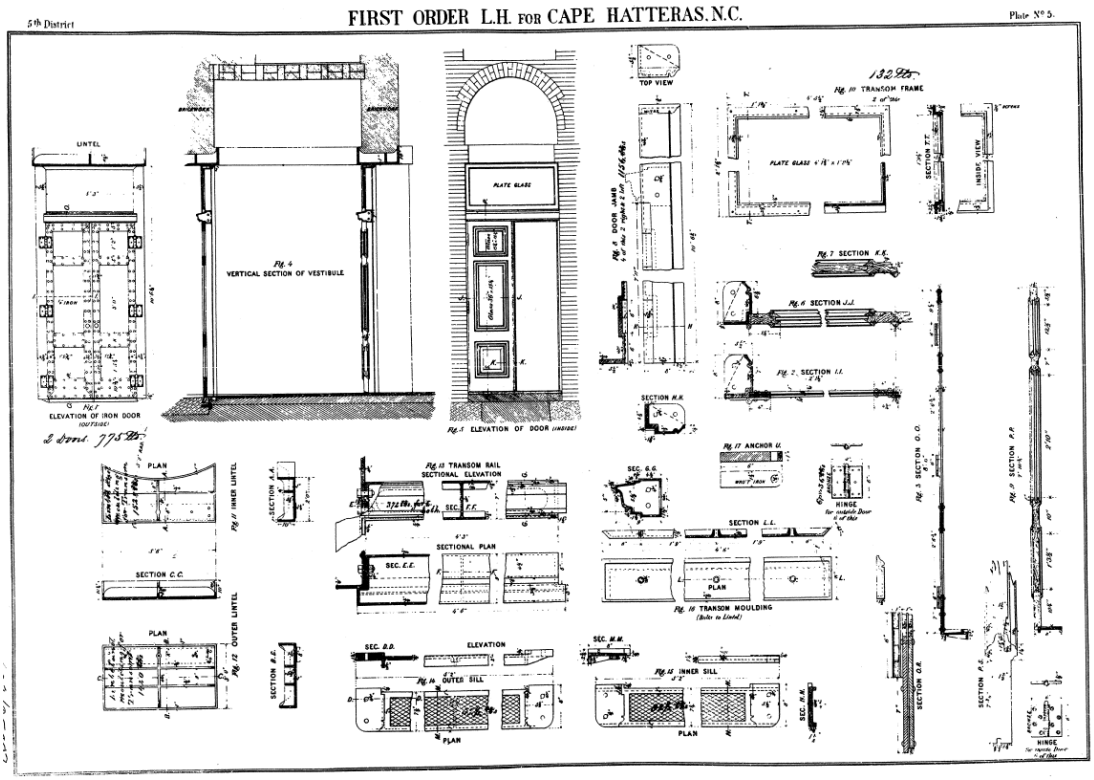


Figure 238. The original drawings for the front entrance. Both the outer door and the inner door are detailed. Drawing: "Specifications," Plate No. 5.

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.

1

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"[21] (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.

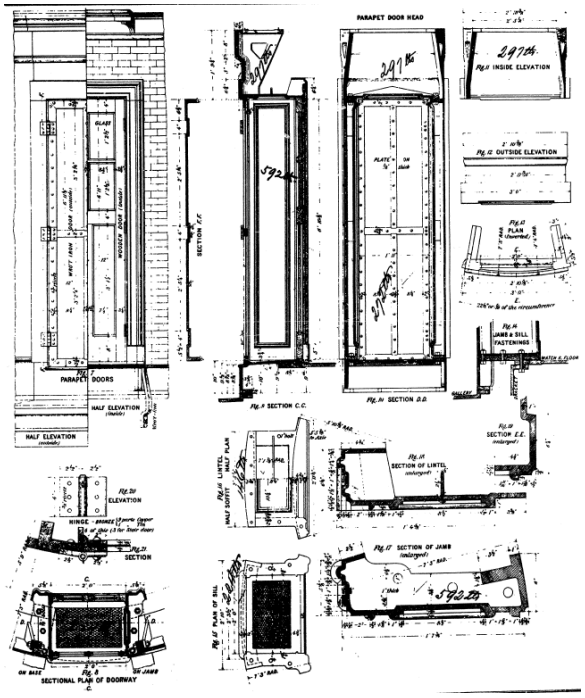


Figure 241. The original drawings for the inner and outer Watch Room doors. Drawing: "Specifications," Plate No. 14. Cropped by author.

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.

[21] 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.

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"."[22]

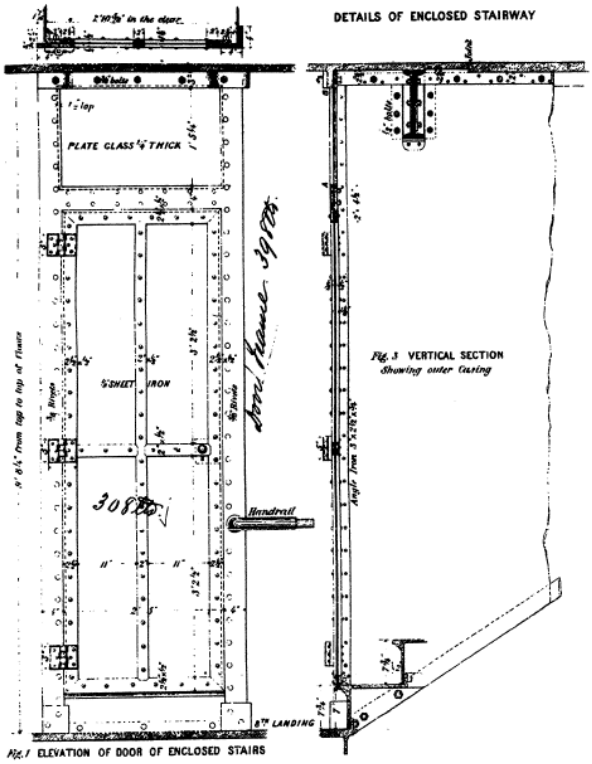


Figure 245. The original drawings for the Service Room interior door. Drawing: "Specifications," Plate No. 11. Cropped by author.

Figure 246. The historic service room interior door. Photo: HPTC, 06/17/15.

[22] JKO/BPE, "Cape Hatteras Lighthouse," p. 15.

C1030	Fittings

Niche Benches & Oil-Storage Tank

Each of the three niches on the first level has two painted brick benches on either side (fig. 147). 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. 148).

Figure 147. The west niche with historic brick oil-storage tank supports capped with metal. Photo: HPTC, 06/17/15.

Figure 148. 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. 149). 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. 150).

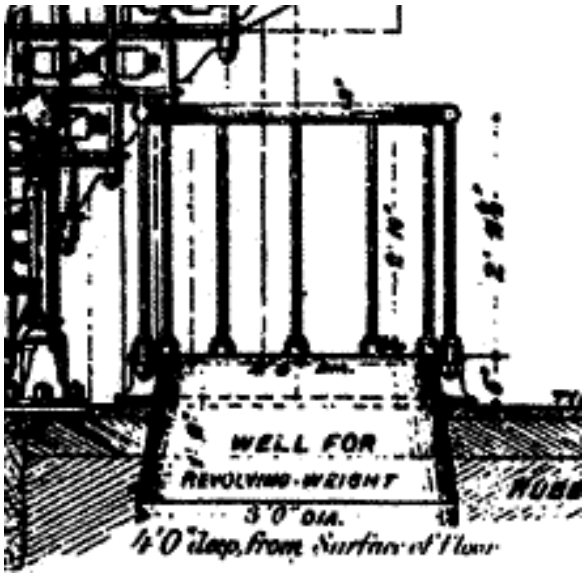


Figure 149. An original drawing showing the weight well. Drawing: "Specifications," Plate No. 7. Cropped by author.

Figure 150. 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. 151). The extant lens was installed in the 1970s (fig. 152).

Figure 152, above. The current lighthouse lens was installed in the 1970s. Photo: HPTC, 06/17/15.

Figure 151 left. A wood railing is located where the lens once stood. 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. 243-54). "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"[23]

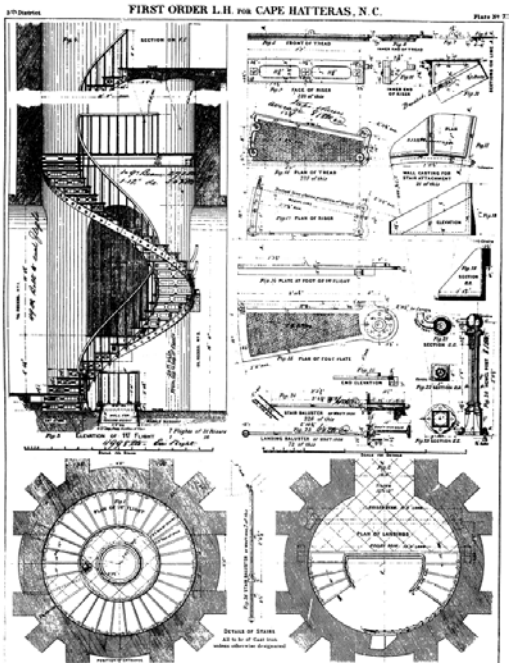


Figure 253. Original drawings detailing the stairs. Drawing: "Specifications," Plate No. 7.

*Figure 254.*The spiral stair runs from the first level to the eighth level. Photo: HPTC, 06/17/15.

[23] 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.

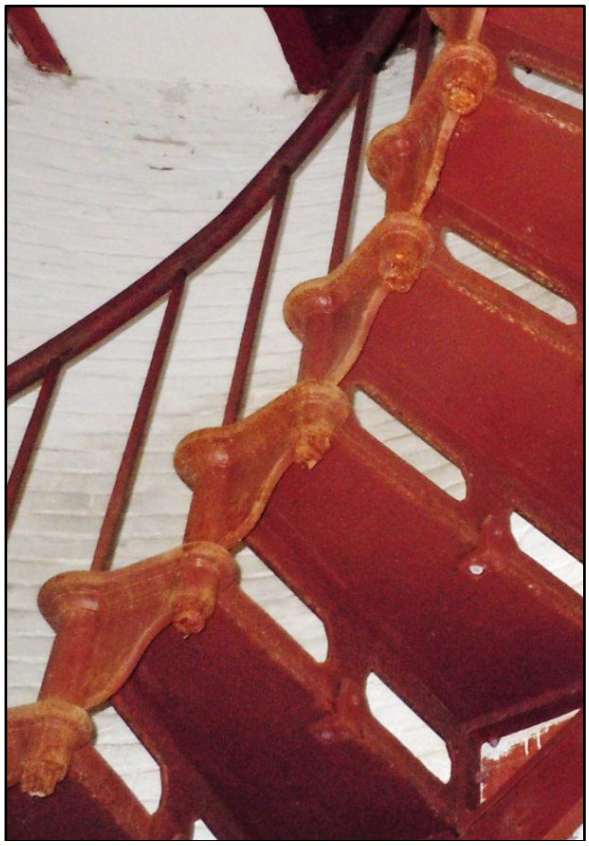


Figure 258. The top tread of the stair below the landing is bolted to the end I-beam as is a nosing through which the balusters run. Photo: HPTC, 06/17/15.

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 261, above. Both of these treads are marked 2008 on their underside. Some are also marked 2002. 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.

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.

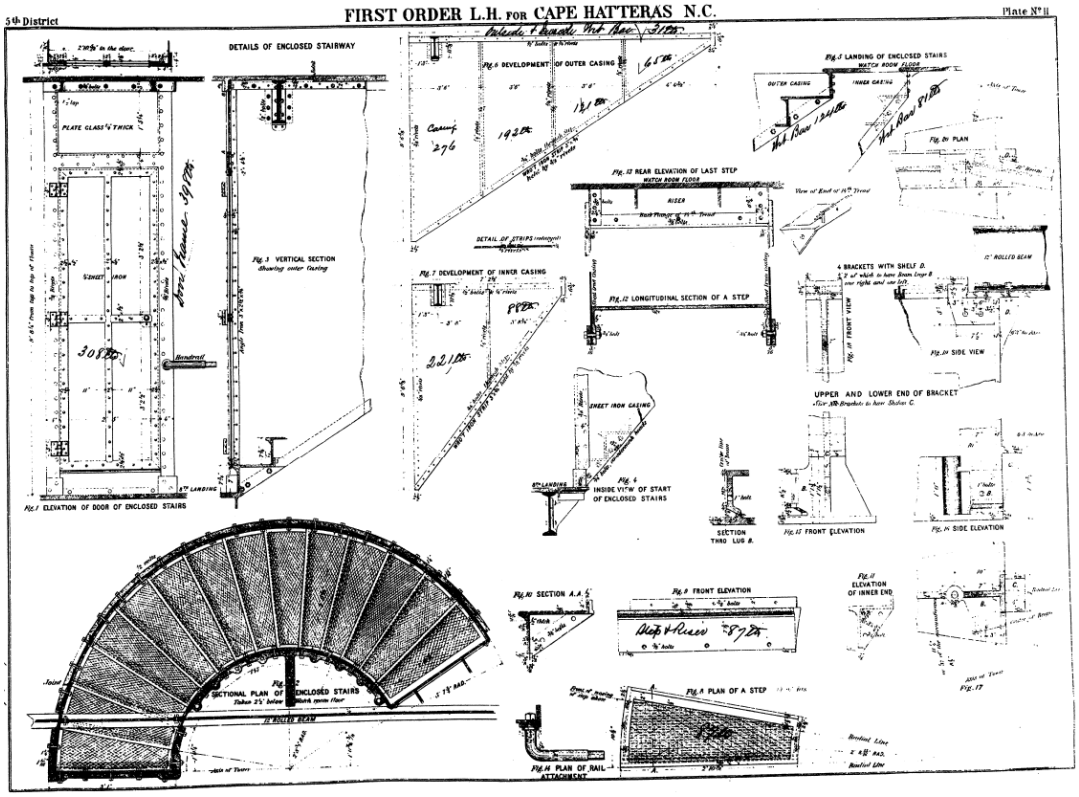


Figure 262. Original drawings detailing the enclosed stairs from the eighth floor to the ninth floor. Drawing: "Specifications," Plate No. 11.

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).[24]

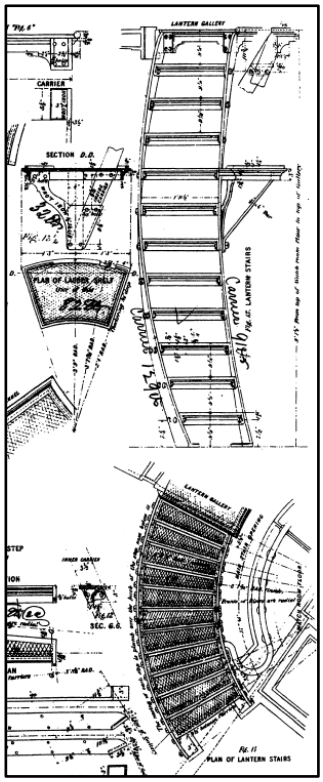


Figure 265. Original drawings detailing the stairs from the Watch Room to the Lantern above. Drawing: "Specifications," Plate No. 16. Cropped by author.

Figure 266. A view down the ladder stair from the lantern. Photo: HPTC, 06/17/15.

[24] JKO/BPE, "Cape Hatteras Lighthouse," pp. 16-17

C201002	Exterior Stair Construction

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).

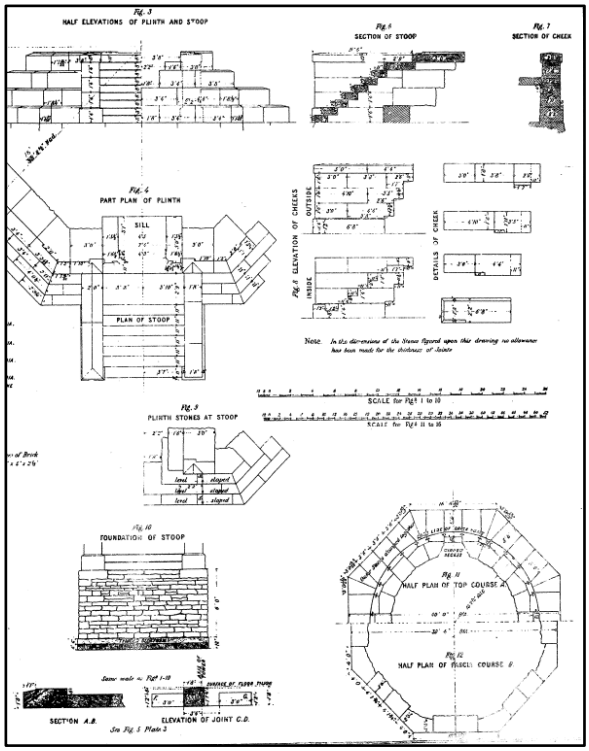


Figure 268, above The exterior stair as it is today, after reconstruction. Photo: HPTC, 06/17/15.

Figure 267, left. Original drawings for the exterior stair. Drawing: "Specifications," Plate No. 4. Cropped by author.

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. [25]

The floor tiling has been retained on every level (figs. 271-72).

[25] "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."[26]

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.

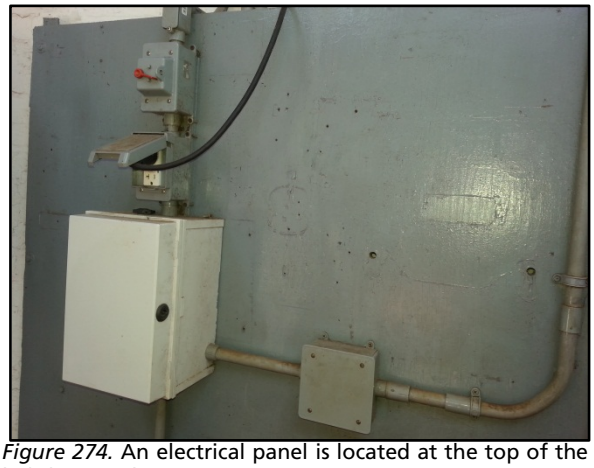


Figure 274. An electrical panel is located at the top of the lighthouse. Photo: HPTC, 06/17/15.

D5030	COMMUNICATIONS & SECURITY

No Communications & Security Systems (fire alarm system, security system, etc.) are extant within the lighthouse.

[26] 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.

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. It is unknown if this walk was reinstalled after the move, but a brick walk does now lead to the front of the lighthouse.

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 (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).

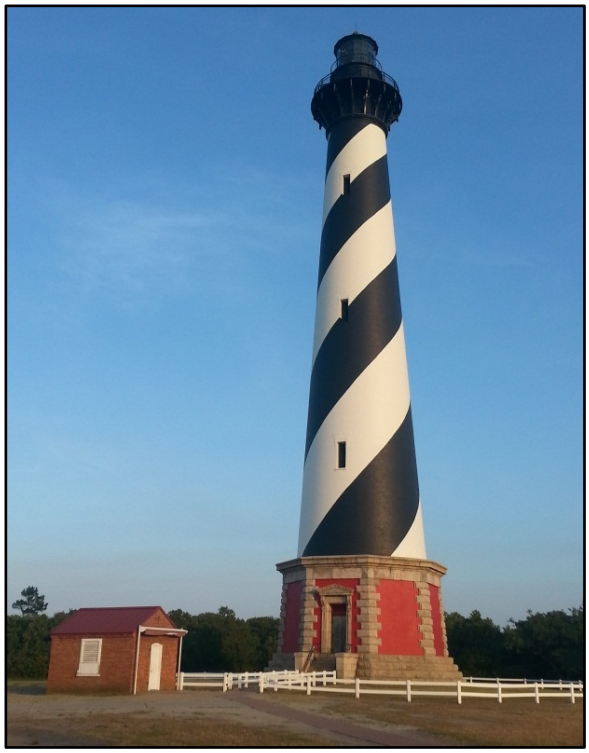

Figure 278. North elevation of the Cape Hatteras Lighthouse. Note four of the original tower windows on this elevation; they lack their original window hoods. Photo: HPTC, 06/18/15.

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).

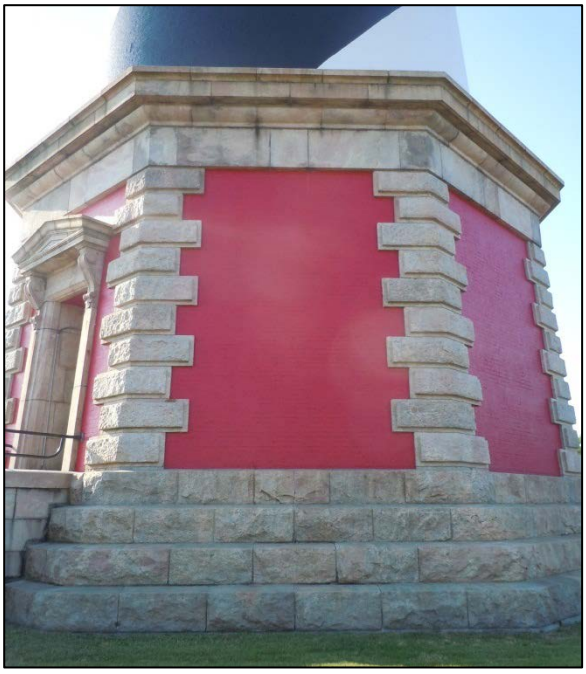

Figure 280. The base is adorned with a granite plinth, quoins, and cornice. Photo: HPTC, 06/17/15.

Figure 281. The gallery is adorned with decorative cast iron elements, including brackets. Photo: HPTC, 06/17/15.

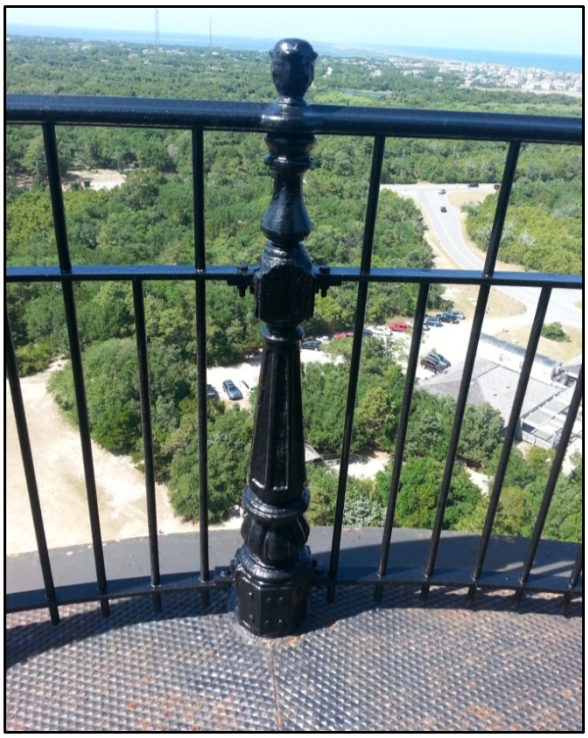

Figure 282, left. A cast iron post on the gallery deck with rail on either side. Photo: HPTC, 06/17/15.

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 2,500 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 2,500 feet 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)

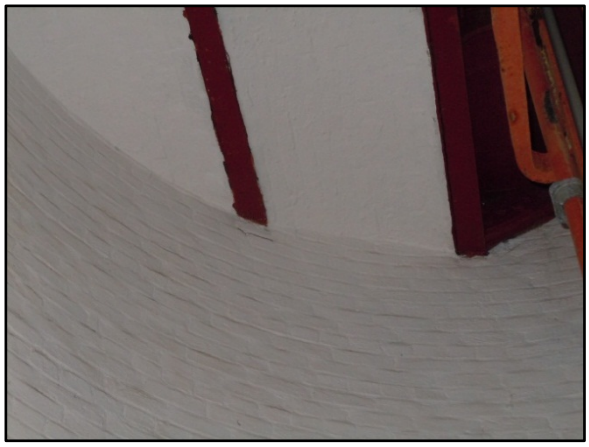

Figure 296. The interior walls are constructed of brick. The individual floor level landings are integrated into the walls. Photo: HPTC, 06/17/15.

Figure 297. 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).

1

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.

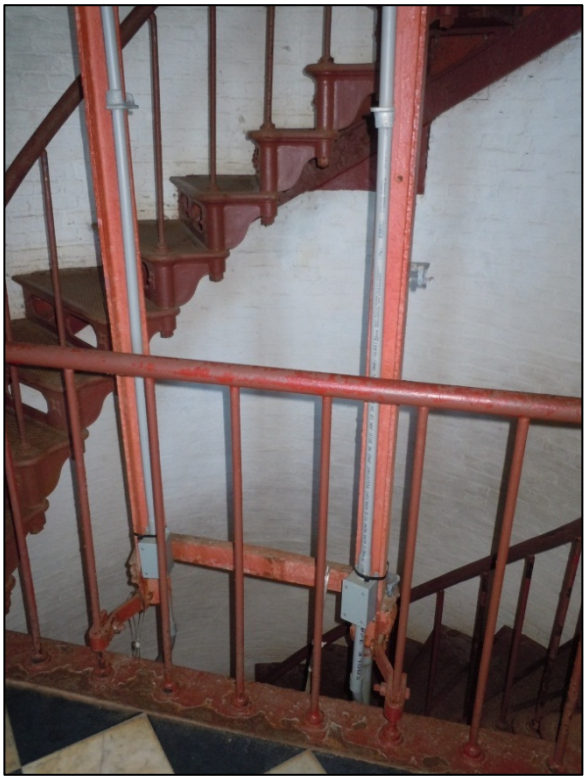

Figure 315. The modern electrical conduit blatantly stands out against the historic structure. Photo: HPTC, 06/17/15.

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 National Capital 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).

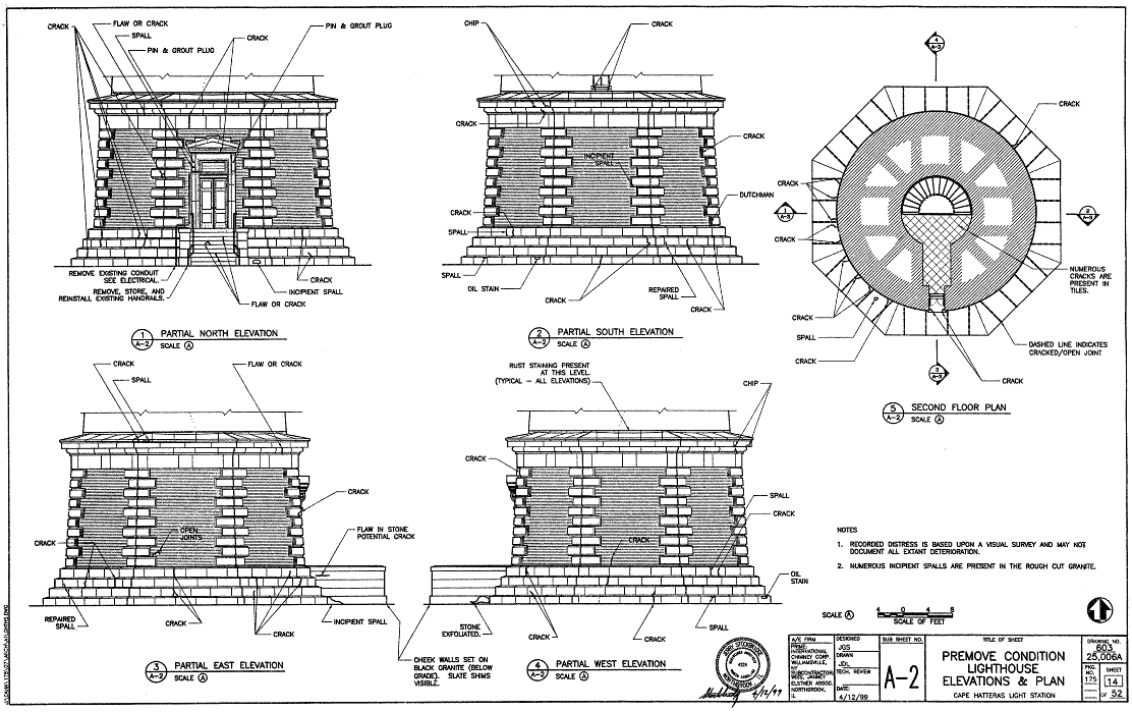

Figure 319. The pre-move condition of the lighthouse plinth was included in the design drawings for the lighthouse move in 1999. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

[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]

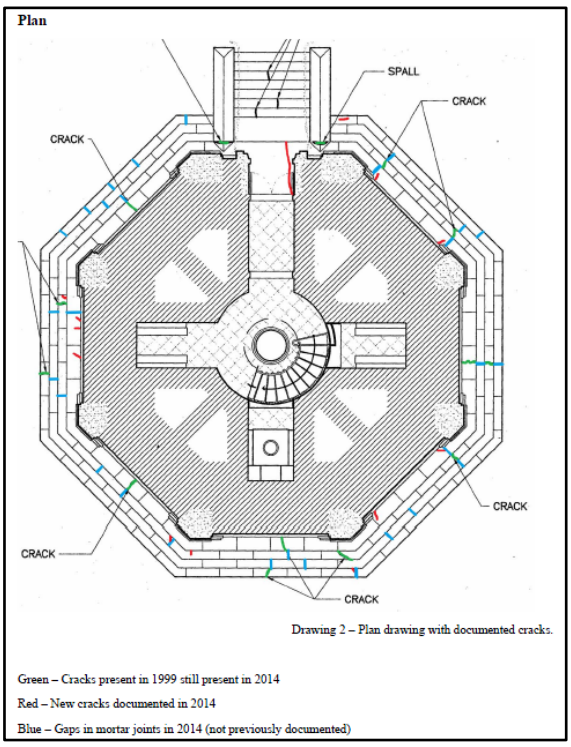

Figure 320. Plan showing the condition assessment of the plinth in 2014 by JKO/BPE. Cropped by author.

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]

Condition Rating: FAIR

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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.

1 Deficiency Rating: SERIOUS

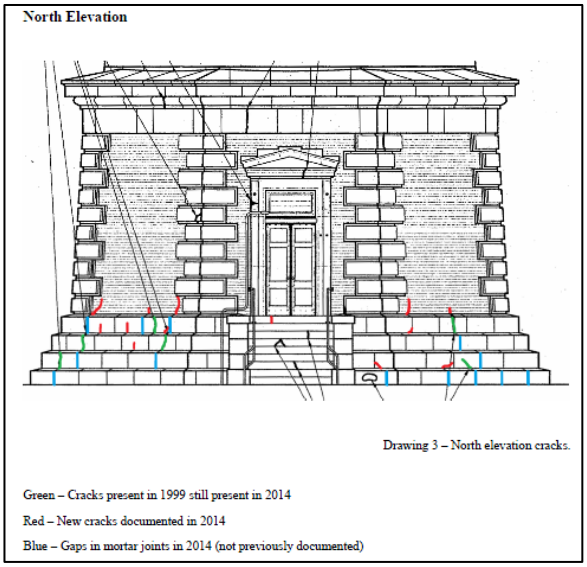

Figure 321. North Elevation drawing showing the condition assessment of the plinth in 2014 by JKO/BPE. Cropped by author.

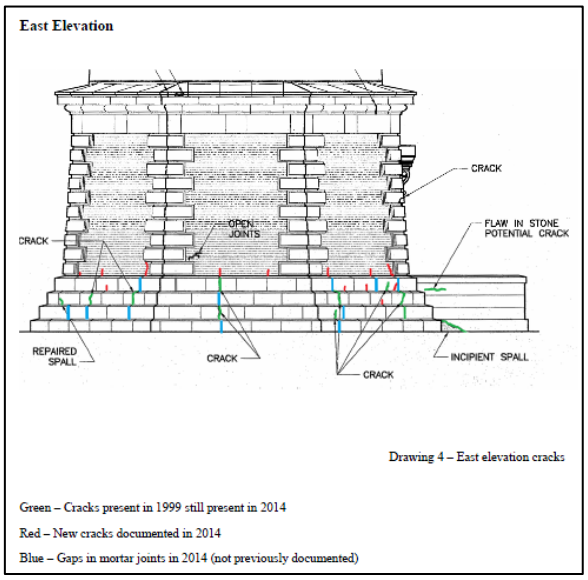

Figure 322. East Elevation drawing showing the condition assessment of the plinth in 2014 by JKO/BPE. Cropped by author.

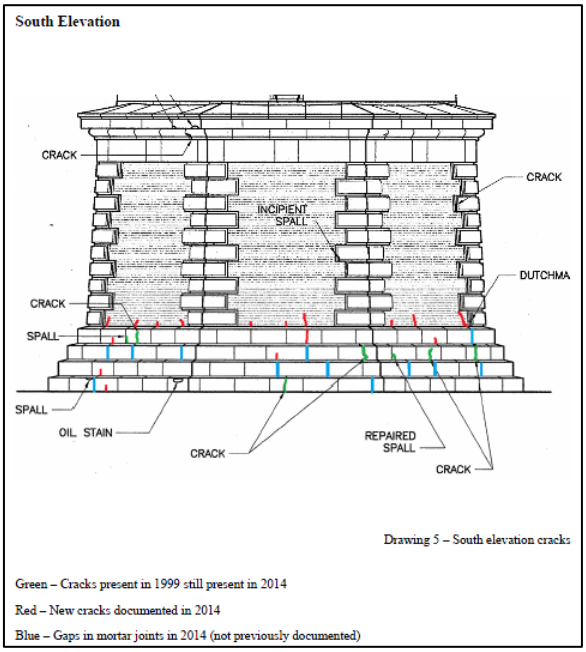

Figure 323. South Elevation drawing showing the condition assessment of the plinth in 2014 by JKO/BPE. Cropped by author.

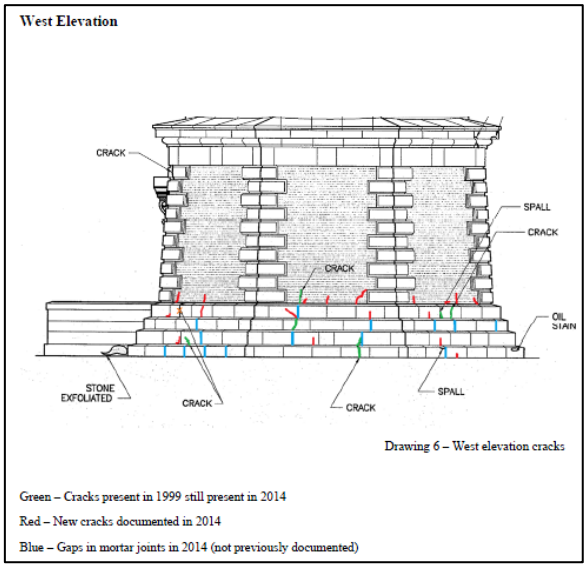

Figure 324. West Elevation drawing showing the condition assessment of the plinth in 2014 by JKO/BPE. Cropped by author.

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 325, above 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 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.[5]

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. . . .[6]

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.[7]

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.[8]

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[5] HHA/WJE, *Comprehensive Structural Analysis Report*, pp. 73-77.
[6] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[7] JKO/BPE, *Condition Assessment Report,* pp. 23-24.
[8] 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.

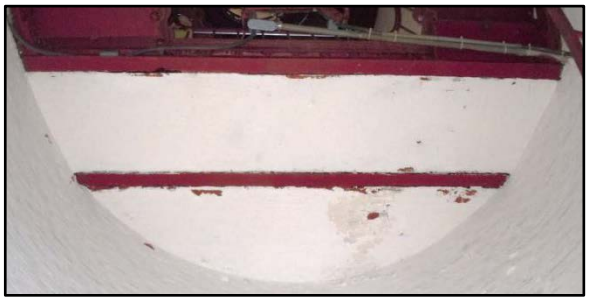

Figure 328. The underside of the Second Level floor deck. Note peeling paint and brick spalling due to water infiltration from above. Photo: HPTC, 06/17/15.

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.[9]

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.[10]

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.[11]

[9] 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.
[10] HHA/WJE, *Comprehensive Structural Analysis Report*, pp. 86-87.
[11] HPA/WJE, "Preservation of Cape Hatteras Lighthouse."

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."[12]

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.[13]

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] JKO/BPE, *Condition Assessment Report,* pp. 30.-32.
[13] 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.[14]

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.[15]

It is assumed that all of this work was completed by ICC in 1991-93.

[14] HHA/WJE, *Comprehensive Structural Analysis Report*, pp. 88-89.
[15] 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.[16]

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.

[16] 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.[17]

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. . . .

[17] 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. . . .[18]

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.[19] 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).[20]

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.

[18] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[19] JKO/BPE, *Condition Assessment Report,* pp. 26, 38.
[20] 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.

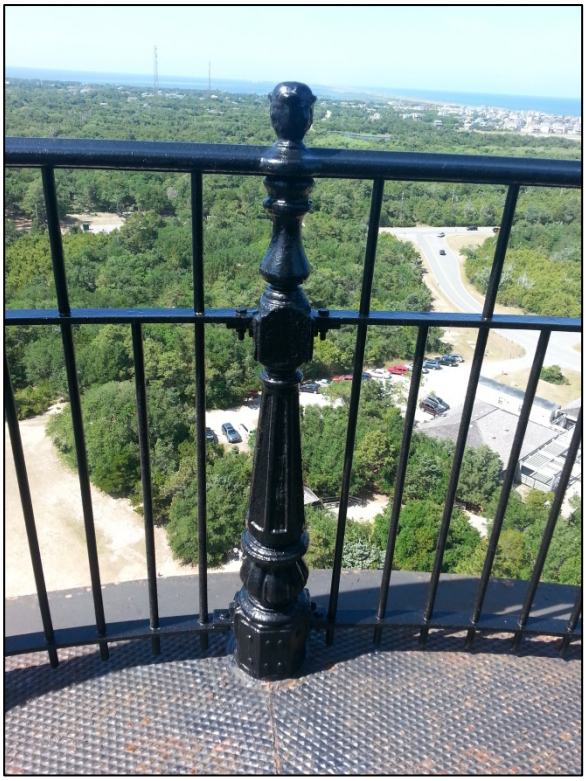

Figure 348. One of the original gallery handrail posts. The railing has been replaced. Photo: HPTC, 06/17/15.

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.[21]

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.[22]

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.[23]

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.[24]

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).[25]

Condition Rating: FAIR
Deficiency Rating: SERIOUS

[21] HHA/WJE, *Comprehensive Structural Analysis Report*, p. 135.
[22] HHA/WJE, *Comprehensive Structural Analysis Report*, pp. 136-139.
[23] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[24] JKO/BPE, *Condition Assessment Report,* p. 26.
[25] 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.[26]

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.[27]

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.[28]

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.[29]

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.

[26] HHA/WJE. *Comprehensive Structural Analysis Report*, pp. 143-144.
[27] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[28] JKO/BPE, *Condition Assessment Report,* pp. 33-34.
[29] 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.[30]

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.[31]

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.[32]

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 existed for a long time, or that they are new cracks which were covered up by the most recent painting.

[30] HHA/WJE, *Comprehensive Structural Analysis Report*, pp. 40-44.
[31] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[32] JKO/BPE, *Condition Assessment Report,* pp. 22-23.

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."[33] 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."[34]

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/

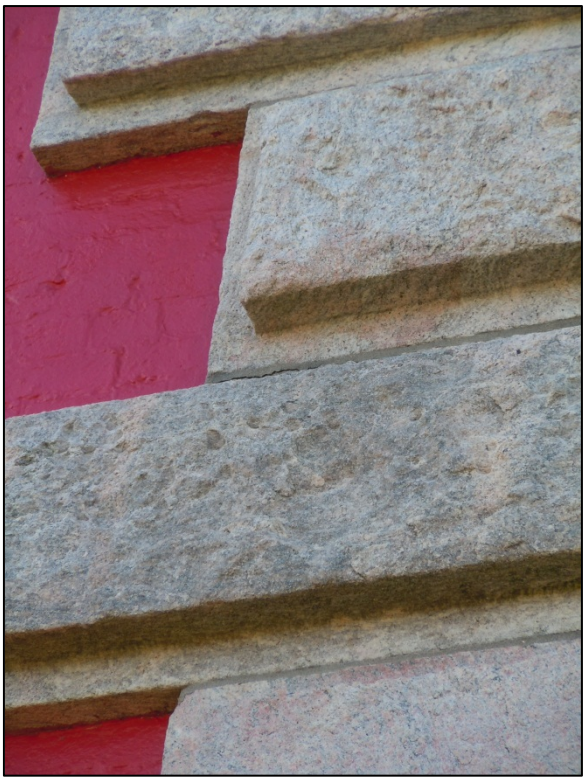

Figure 356. Some of the mortar between the quoins is failing or missing. Photo: HPTC, 06/17/15.

[33] Hains, Peter C., Captain of Engineers. *Letter to Major George H. Elliot, Engineering Secretary, Chairman, U.S. Light-House Board.* March 22, 1873. NARA.
[34] 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.[35]

The 1989 preservation drawings of the lighthouse noted the following regarding the exterior tower walls:

[35] 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.[36]

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).

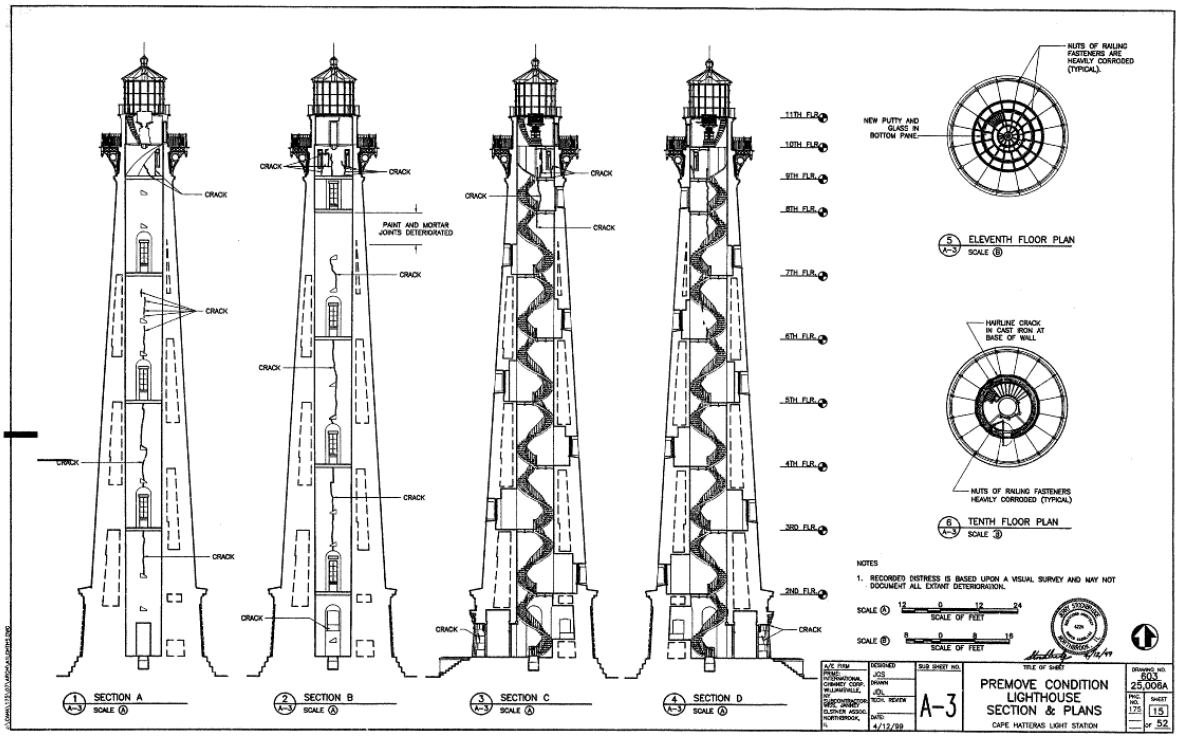

Figure 357. The pre-move condition of the lighthouse interior was included in the design drawings for the lighthouse move in 1999. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

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.

[36] 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.[37]

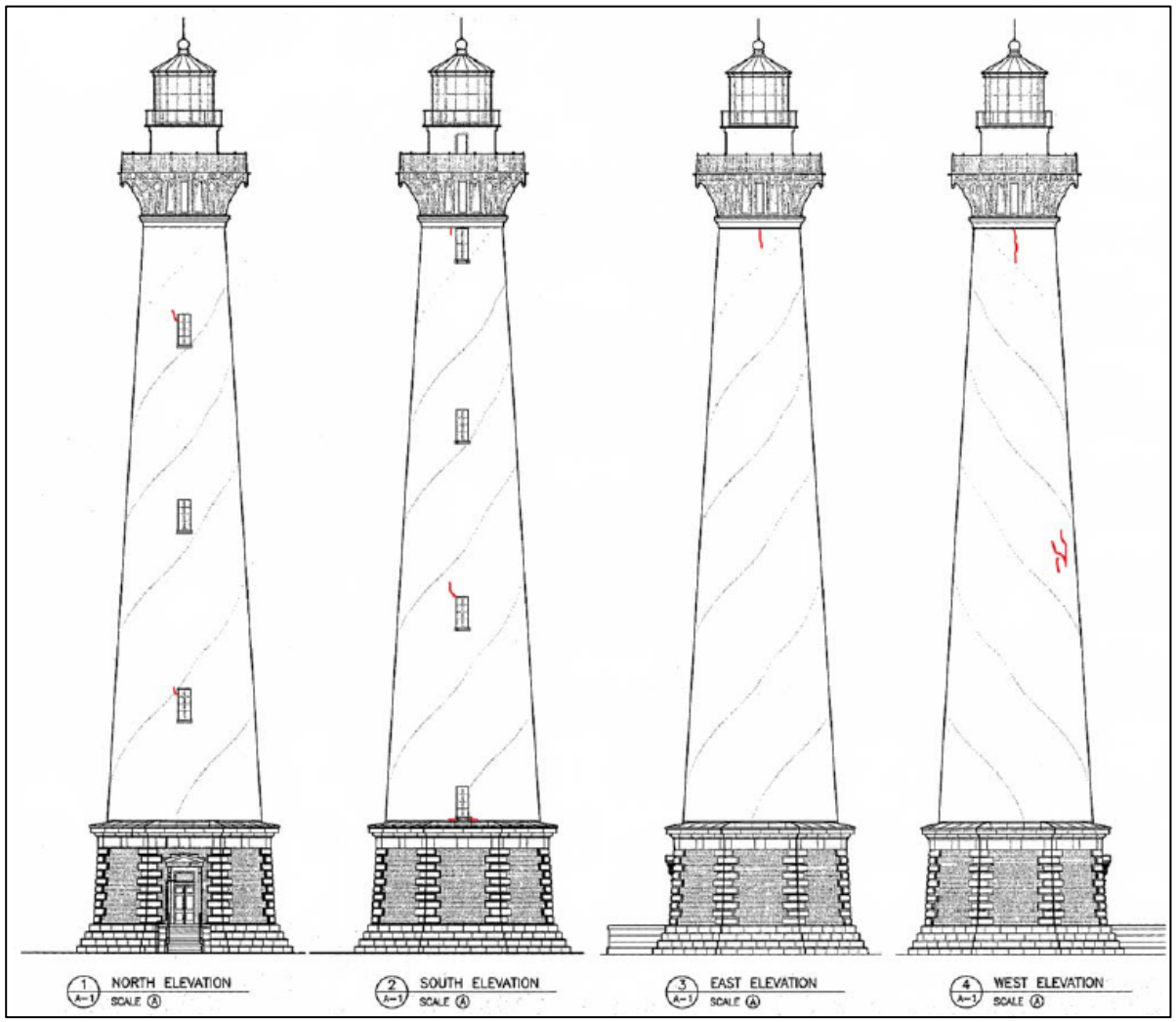

Figure 358. Exterior elevations showing the condition assessment of the tower walls in 2014 by JKO/BPE. The red lines denote new cracks documented in 2014. Cropped by author.

[37] JKO/BPE, *Condition Assessment Report,* p. 23.

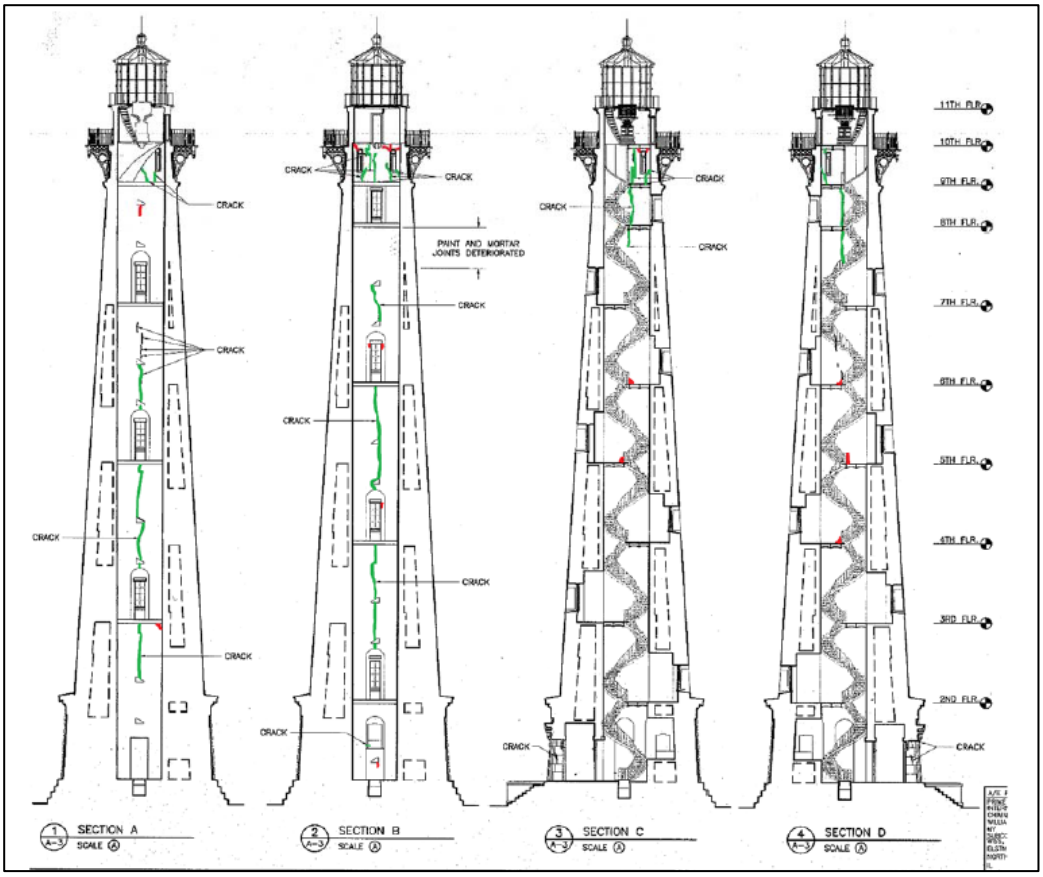

Figure 359. Sections through the tower showing the condition assessment of the interior faces of the tower walls in 2014 by JKO/BPE. The green lines denote cracks documented in 1999 prior to the move. The red lines denote new cracks documented in 2014. Cropped by author.

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.[38]

[38] 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.[39] 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.[40]

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.[41]

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.[42]

Condition Rating: FAIR
Deficiency Rating: SERIOUS

[39] HHA/WJE, *Comprehensive Structural Analysis Report*, pp. 116-120.
[40] HHA/WJE, *Comprehensive Structural Analysis Report*, pp. 44-65.
[41] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[42] 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.[43]

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).[44]

It is assumed that all of this work was completed by ICC in 1991-93.

[43] HHA/WJE, *Comprehensive Structural Analysis Report*, p. 106-116.
[44] 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).[45]

Condition Rating: FAIR
Deficiency Rating: MINOR

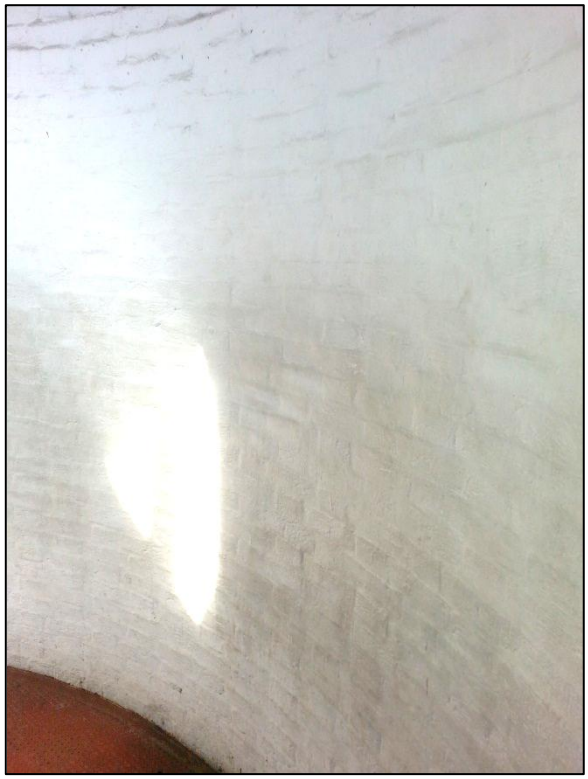

Figure 366. The interior surfaces of the Tenth Level exterior wall are in good condition. Photo: HPTC, 06/17/15.

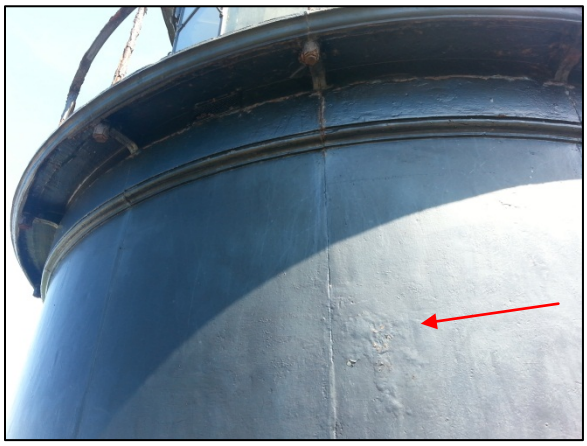

Figure 367. The exterior wall plates show old deterioration. Photo: HPTC, 06/17/15.

Figure 368. Paint peeling from the exterior wall plates has caused rust to form. Photo: HPTC, 06/17/15.

[45] 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.[46]

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.[47]

[46] 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.[48]

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.[49]

Condition Rating: FAIR
Deficiency Rating: MINOR

Figure 369. The exterior of the Lantern curtain wall system. Photo: HPTC, 06/16/15.

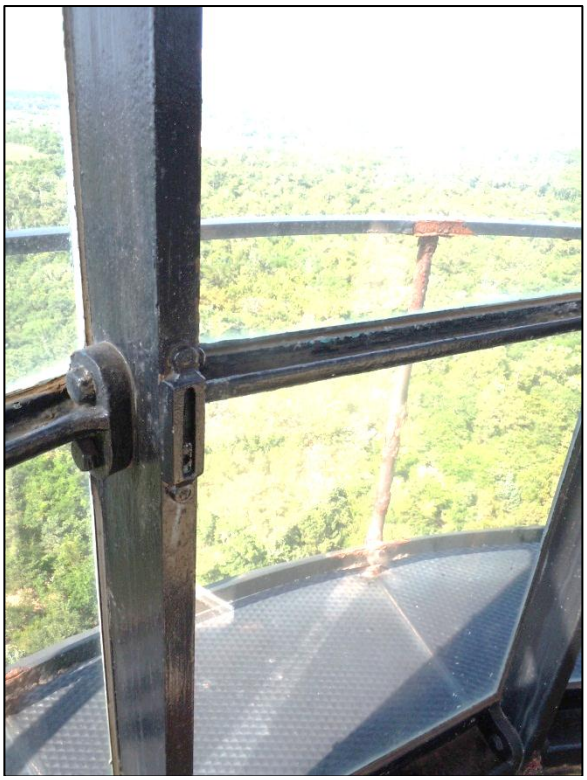

Figure 370, right. The interior of the Lantern curtain wall system. Photo: HPTC, 06/16/15.

[47] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[48] JKO/BPE, *Condition Assessment Report,* p. 35.
[49] 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.

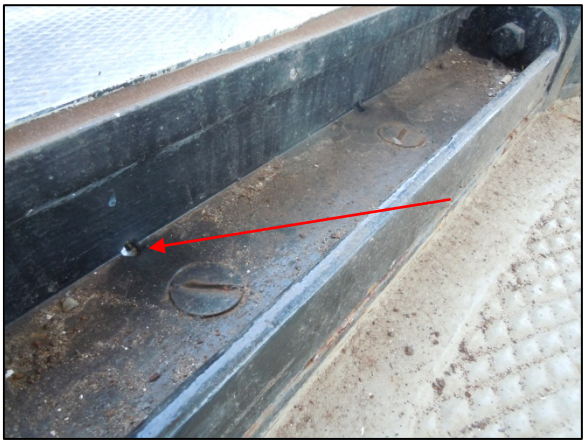

*Figure 372. B*ase of one segment of the curtain wall with weep hole dating to 1991-93 work. Photo: HPTC, 06/16/15.

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.[50]

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.[51]

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.

[50] HHA/WJE, *Comprehensive Structural Analysis Report,* pp. 78-83.
[51] 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.[52]

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.[53] However, it is assumed the extant colors are what they were historically.

Condition Rating: POOR
Deficiency Rating: CRITICAL

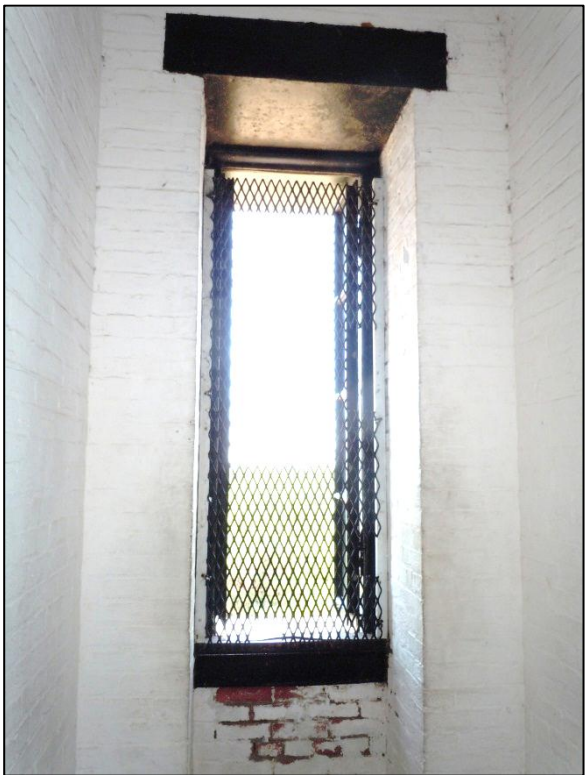

Figure 374, above. Water infiltration is affecting the wall below the window on the Second Level. Photo: HPTC, 06/17/15.

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.

[52] JKO/BPE, *Condition Assessment Report,* p. 25.
[53] 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.[54]

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. [55]

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.

[54] HHA/WJE, *Comprehensive Structural Analysis Report,* pp. 78-83.
[55] 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.[56]

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.[57] 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

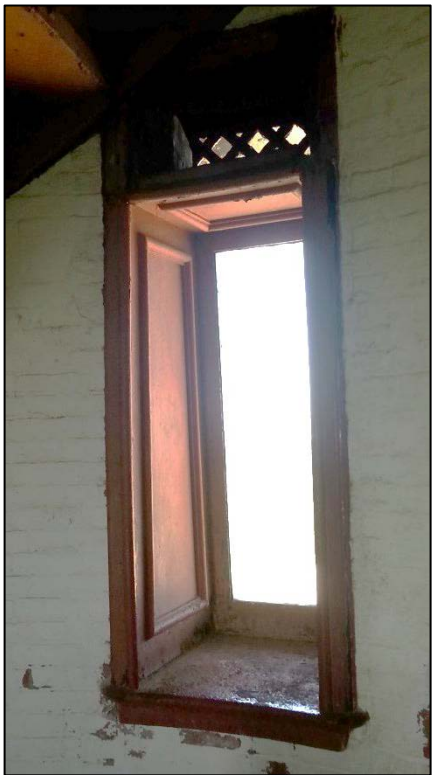

Figure 380, above. The transom above the northeast Service Room window shows a lot of deterioration and missing pieces. Photo: HPTC, 06/17/15.

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.

[56] JKO/BPE, *Condition Assessment Report,* p. 25.
[57] Great Lakes Lighthouse Keepers Association. "Instructions to Light-Keepers," p. 53.

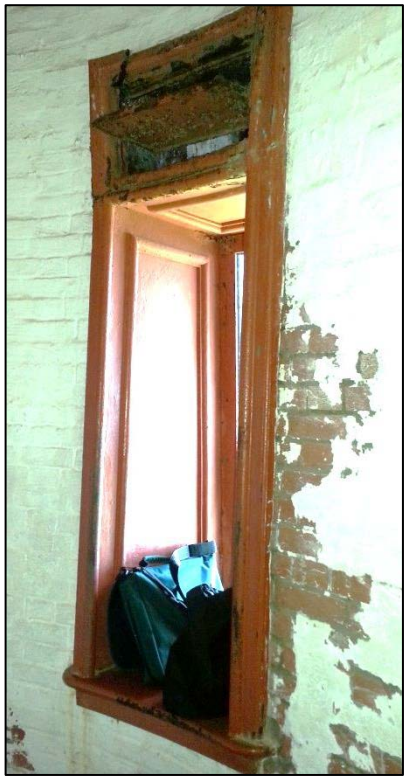

Figure 382. The transom over the southeast window is deteriorated, likely beyond repair. Photo: HPTC, 06/17/15.

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. . . .[58]

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.[59]

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.[60]

The bronze doors are unpainted. The door surround is painted. In 2014, the paint was noted to be "blistering and chipping."[61]

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

[58] HHA/WJE, *Comprehensive Structural Analysis Report*, p. 84.
[59] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[60] JKO/BPE, *Condition Assessment Report,* p. 26.
[61] 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.[62]

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.[63]

It is assumed that the repair work was completed in 1991-93 by ICC.

[62] HHA/WJE, Comprehensive Structural Analysis Report, pp. 106-107.
[63] 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."[64]

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

[64] 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.[65]

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.[66]

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.

[65] HHA/WJE, *Comprehensive Structural Analysis Report*, p. 84.
[66] 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.[67] 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.[68] 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).[69]

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.

[67] HHA/WJE, *Comprehensive Structural Analysis Report,* p. 88.
[68] JKO/BPE, *Condition Assessment Report,* p. 26.
[69] 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.[70]

The 1989 preservation drawings noted the following regarding typical treatment to the main interior stair:

> <u>GENERAL STAIR REPAIR NOTES</u>
>
> 1. The damage indicated on the schedule is a listing of all damage found during field surveys of the stair system. <u>Special repair treatment is required only in the highlighted rows & columns on the schedule.</u>
> 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 treat & 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. . . .

[70] 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. . . .[71]

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.[72]

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]."[73]

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

[71] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[72] JKO/BPE, *Condition Assessment Report,* pp. 23-24.
[73] 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.[74]

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.

[74] 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.[75]

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."[76] 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.[77]

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."[78]

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

[75] HHA/WJE. *Comprehensive Structural Analysis Report.*
[76] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[77] JKO/BPE, *Condition Assessment Report,* pp. 23-24.
[78] 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.[79]

The 1989 preservation drawings noted the following regarding repair work to the Lantern ladder: "Clean rust & loose paint from all surfaces. Prime & repaint."[80] 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.[81] 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.[82] 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).[83]

[79] HHA/WJE. *Comprehensive Structural Analysis Report.*
[80] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[81] JKO/BPE, *Condition Assessment Report,* pp. 32-33.
[82] 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.

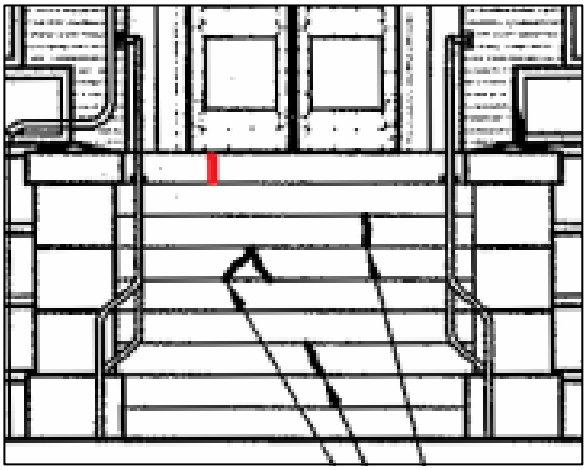

Figure 403. The front (north) elevation of the stair from the JKO/BPE report shows no change to the conditions documented in 1999. Cropped by author.

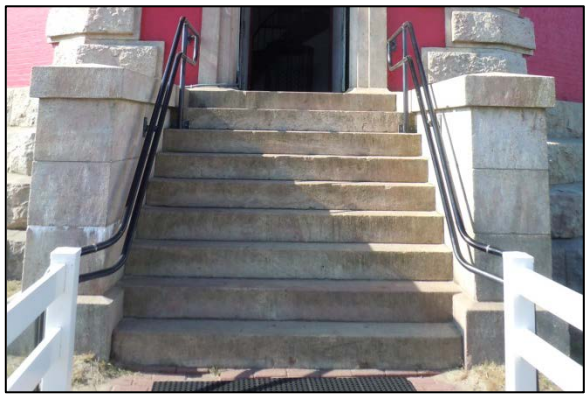

Figure 404. The front north elevation as seen by HPTC. Photo: 06/17/15.

[83] JKO/BPE, *Condition Assessment Report,* Appendix pp. 4-14.

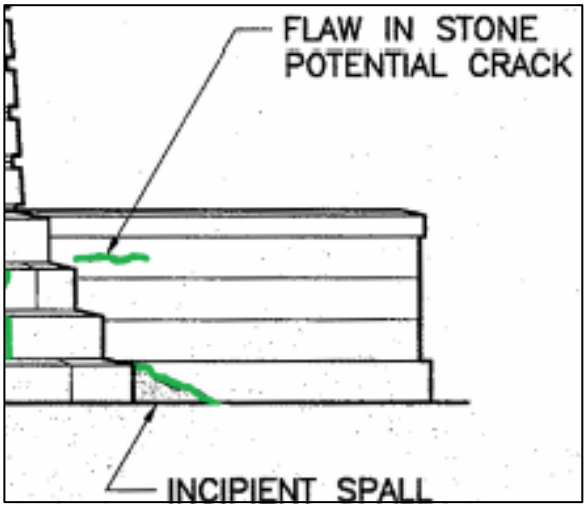

Figure 405. The east elevation from the 2014 JKO/BPE report shows no change to the conditions documented in 1999. Cropped by author.

Figure 406. The east elevation as seen by HPTC. Photo: 06/17/15.

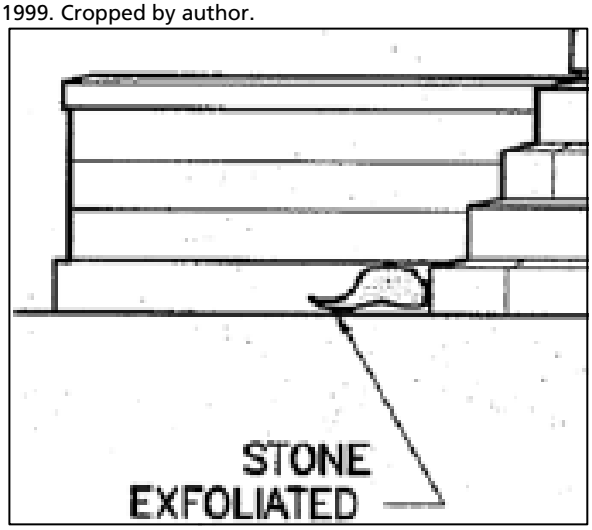

Figure 407. The west elevation from the 2014 JKO/BPE report shows no change to the conditions documented in 1999. Cropped by author.

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."[84]

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

[84] 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 Light Station is listed as a contributing structure in the Cape Hatteras Light Station National Historic Landmark District and any undertakings (expenditure of federal funds) will be reviewed in accordance to NPS policy and federal historic preservation laws including the service-wide *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:

<u>Preservation</u>: "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.

DO-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 Public Buildings Amendments of 1988, 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 will not be provided. However, it should be noted that modifications may be likely as property use

[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.

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.

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.[3]

[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] JKO/BPE, *Condition Assessment Report,* p. 43.

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.

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.[4]

[4] NPS, USLS. *Historic Lighthouse Preservation Handbook.* 1997. Accessed at http://www.nps.gov/maritime/nhlpa/handbook.htm. Part IV. B, pp. 18-25.

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.[5]

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.[6]

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.

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.[7]

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

[5] HHA/WJE, *Comprehensive Structural Analysis Report,* pp. 78-83.
[6] JKO/BPE, *Condition Assessment Report*, p. 40.
[7] Accessible at https://www.osha.gov/Publications/osha3142.pdf.

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.

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.[9]

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).

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.[8]

[8] Accessed at http://www.multisafe.co.za/photo-gallery/page/2/ on October 15, 2015.
[9] NPS, USLS. *Historic Lighthouse Preservation Handbook.* Part IV. B, pp. 18-25.

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.[10]

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/).

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

[10] JKO/BPE, *Condition Assessment Report,* p. 43.

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.[11]

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/).

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

[11] 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 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]

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."[13]

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.

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.

[12] NPS, USLS. *Historic Lighthouse Preservation Handbook*. Part IV. B, pp. 18-25.
[13] JKO/BPE, *Condition Assessment Report,* p. 40.

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.[14]

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.[15]

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.

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 repainting.

[14] NPS, USLS. *Historic Lighthouse Preservation Handbook*. Part IV. B, pp. 18-25.
[15] JKO/BPE, *Condition Assessment Report,* p. 43.

- 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.[16]

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."[17]

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.

For further information, consult NPS Preservation Brief 27: The Maintenance and Repair of Architectural Cast Iron.

[16] NPS, USLS. *Historic Lighthouse Preservation Handbook*. Part IV. A, p. 19.
[17] JKO/BPE, *Condition Assessment Report*, p. 40.

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.[18]

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.[19]

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.

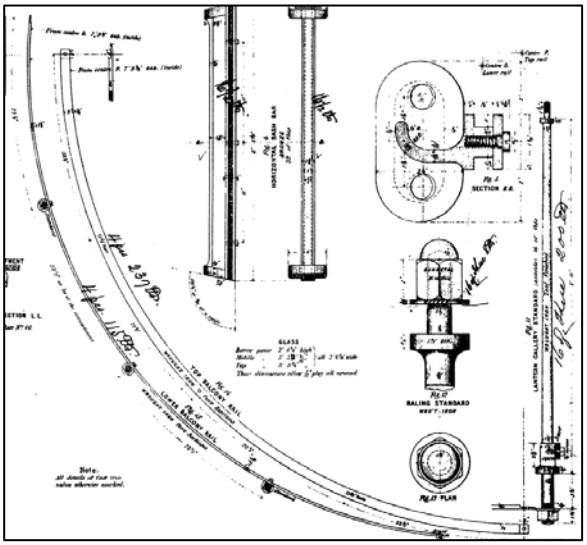

Figure 419. The original specification drawings show the original design intention of the Lantern exterior balcony railing. Source: Plate No. 17.

All eight vents which communicate from the interior of the lantern to the exterior (below the exterior lantern balcony) should be scoped for 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/).

[18] NPS, USLS. *Historic Lighthouse Preservation Handbook*. Part IV. B, pp. 18-25.
[19] JKO/BPE, *Condition Assessment Report,* p. 40.

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.[20]

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.

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.

[20] NPS, USLS. *Historic Lighthouse Preservation Handbook.* Part IV. B, pp. 18-25.

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.[21]

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."[22]

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.

- 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 repainting.
- 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.[23]

[21] NPS, USLS. *Historic Lighthouse Preservation Handbook.* Part IV. B, pp. 18-25.
[22] JKO/BPE, *Condition Assessment Report,* p. 29.
[23] NPS, USLS. *Historic Lighthouse Preservation Handbook, P*art IV. A, p. 19.

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.
- 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.[24]

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.

[24] NPS, USLS. *Historic Lighthouse Preservation Handbook*. Part IV. A, pp. 16-17.

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.[25]

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 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 repainting.
- 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.[26]

[25] NPS, USLS. *Historic Lighthouse Preservation Handbook*. pp. 16-17.

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 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 exterior 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-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.[27]

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.

[26] NPS, USLS. *Historic Lighthouse Preservation Handbook,* Part IV. A, p. 19.
[27] NPS, USLS. *Historic Lighthouse Preservation Handbook.* Part IV. B, pp. 18-25.

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[28].

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 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 repainting.
- 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.[29]

For further information, consult NPS Preservation Brief 2: Repointing Mortar Joints in Historic Masonry Buildings for more information.

[28] Ibid, Part IV. A, pp. 16-17.
[29] NPS, USLS. *Historic Lighthouse Preservation Handbook*. Part IV. A, p. 19.

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."[30]

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 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

[30] JKO/BPE, *Condition Assessment Report,* pp. 40, 43.

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.[31]

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 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.[32]

[31] NPS, USLS. *Historic Lighthouse Preservation Handbook*. Part IV. B, pp. 18-25.
[32] NPS, USLS. *Historic Lighthouse Preservation Handbook*. Part IV. B, pp. 18-25.

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.

B3010 Roof Coverings	FAIR	MINOR

Timeframe: *Ongoing*

The roof should be inspected periodically to ensure that it is in good structural condition.

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.[33]

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 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.[34]

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.

[33] NPS, USLS. *Historic Lighthouse Preservation Handbook*. Part IV. B, pp. 18-25.
[34] JKO/BPE, *Condition Assessment Report,* pp. 38, 40.

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.

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.

Effects of Recommended Treatments

The potential effects of the recommended treatments for preservation are outlined in the Table 3. 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 4. **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.

NPS Document # 603 129279 2015

Appendix A

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Appendix A: Bibliography

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Appendix B

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Appendix B: Glossary of Terms & Abbreviations

Glossary of Terms (alphabetical order)[1]

ashlar masonry	Blocks of accurately dressed, cut, squared, and finished stone, faced with clean, sharp edges, forming perfect courses, laid in mortar
batter	Inclined from the vertical; in a wall: when it recedes as it rises
belt course	Flat, raised horizontal strip on a façade, occasionally ornamented, sometimes coinciding with sills or floor levels
casement	Window frame with hinged sashes hung from a vertical member of the fixed frame
conical	Form resembling a cone
cornice	Crowning, projecting molded horizontal top of a building, some part of a building, or a wall
Flemish bond	In brickwork, a bond in which each course consists of headers and stretchers laid alternately; each header is centered with respect to the stretcher above and the stretcher below it
grillage	Heavy framework of cross timbers or other beams forming a foundation, especially on unstable ground
header course	Course of brick composed entirely of exposed headers (short side)
hood	Canopy or cover above an aperture, such as a window, to protect it from the weather
monolithic	Characterized by massiveness and complete uniformity
niche	Shallow, ornamental recess in a wall or pier
parabolic	Curve based on a conic section (intersection of a cone with a plane parallel to its side)
pinnacle	Terminating feature of a spire, turret, etc., often ornamented
plinth	Recognizable base of an external wall, or the base courses of a building collectively, if so treated as to give the appearance of a platform
quarry-faced	Descriptive of the freshly split face of ashlar, as it comes from the quarry, squared off only for the joints; usually used in massive masonry work

[1] The definitions were compiled from two sources:
Curl, James Stevens. "A Dictionary of Architecture and Landscape Architecture." Oxford University Press: England, 2006.
Harris, Cyril M. (ed.) "Illustrated Dictionary of Historic Architecture." Dover Publications, Inc.: New York, 1977.

quoin	Hard stone or brick used, with similar ones, to reinforce an external corner or edge of a wall or the like; often distinguished decoratively from adjacent masonry
relieving arch	Usually segmental, built flush with the wall surface over a lintel to relieve the wall from the weight of the masonry above, and to discharge forces away from the lintel
swale	Shallow depression
veneer	Protective or ornamental facing of brick or stone

Glossary of Abbreviations (alphabetical order)

ACOE	Army Corps of Engineers
BFML	Building Feature Master List
CAHA	Cape Hatteras National Seashore
CCC	Civilian Conservation Corps
CDF	character-defining feature
CSLB	Confederate States Lighthouse Bureau
DCP	Design Concept Plan
DSC	Denver Service Center
EA	Environmental Assessment
FMSS	Facility Management Software System
FONSI	Finding of No Significant Impact
GMP	General Management Plan
HABS	Historic American Building Survey
HHA/WJE	Hasbrouck Hunderman Architects/Wiss, Janney, Elstner Associates, Inc.
HPTC	Historic Preservation Training Center
HSR	Historic Structure Report
ICC	International Chimney Corporation
JKO/BPE	Joseph K. Oppermna—Architect, P.A./Bennett Preservation Engineering, PC
NAS	National Academy of Sciences
NPS	National Park Service
NRC	National Research Council
OBPA	Outer Banks Preservation Association
PA	Programmatic Agreement
SERO	Southeast Regional Office
SHPO	State Historic Preservation Office

USCG	United States Coast Guard
USLHB	United States Light-House Board
USLHE	United States Light House Establishment
USLHS	United States Light House Service
WPA	Works Progress Administration

Appendix C

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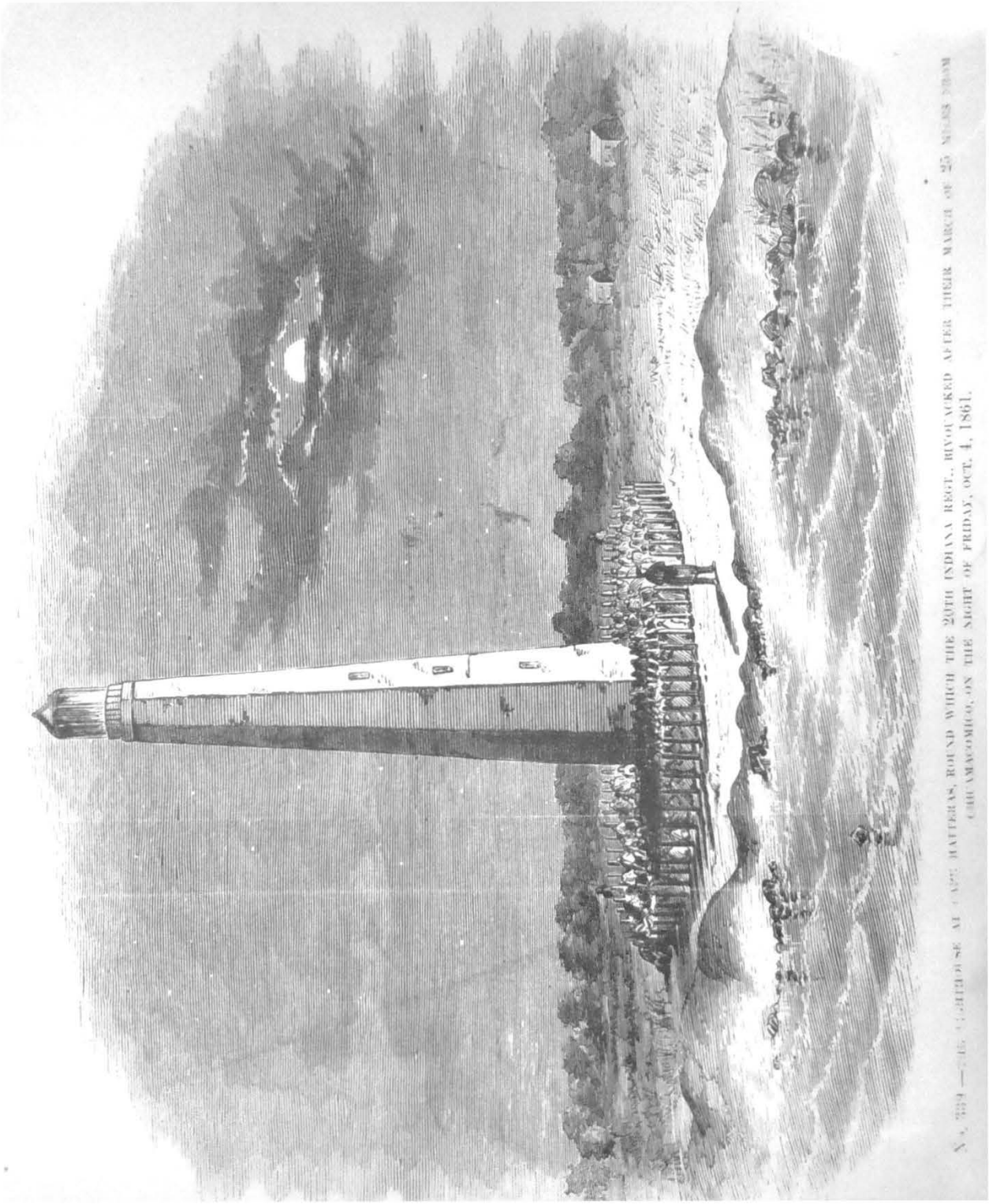
Appendix C: Archival Photographs

Archival photographs were found at the following repositories:

- Cape Hatteras National Seashore archives, Manteo, NC
- Harpers Ferry Center photographic archives, Shepherdstown, WV
- Library of Congress website
- National Archives and Records Administation website



"No. 339—THE LIGHTHOUSE AT CAPE HATTERAS. ROUND WHICH THE 20TH INDIANA REGT., BIVOUACKED AFTER THEIR MARCH OF 25 MILES FROM CHICAMOCOMICO, ON THE NIGHT OF FRIDAY, OCT. 4, 1861."
Cape Hatteras National Seashore Archives: Cape Hatteras Light Station Photos, Box 1 of 6, Cape Hatteras Lighthouse A

"Old Tower Cape Hatteras NC Oct 24 '70 View from the West, Sketched by Geo. B. Nicholson."
National Archives and Records Administration, Site File, Cape Hatteras Light Station, RG 26 and Harpers Ferry Center photographic archives.

Cape Hatteras National Seashore Archives, Cape Hatteras Light Station Photos, Box 1 of 6, Cape Hatteras Lighthouse A and Harpers Ferry Center photographic archives

"9.C.S.7. CAPE HATTERAS LT.STA., N.C. MAY 30, 1893."
Cape Hatteras National Seashore Archives, Cape Hatteras Light Station Photos, Box 1 of 6, Cape Hatteras Lighthouse A

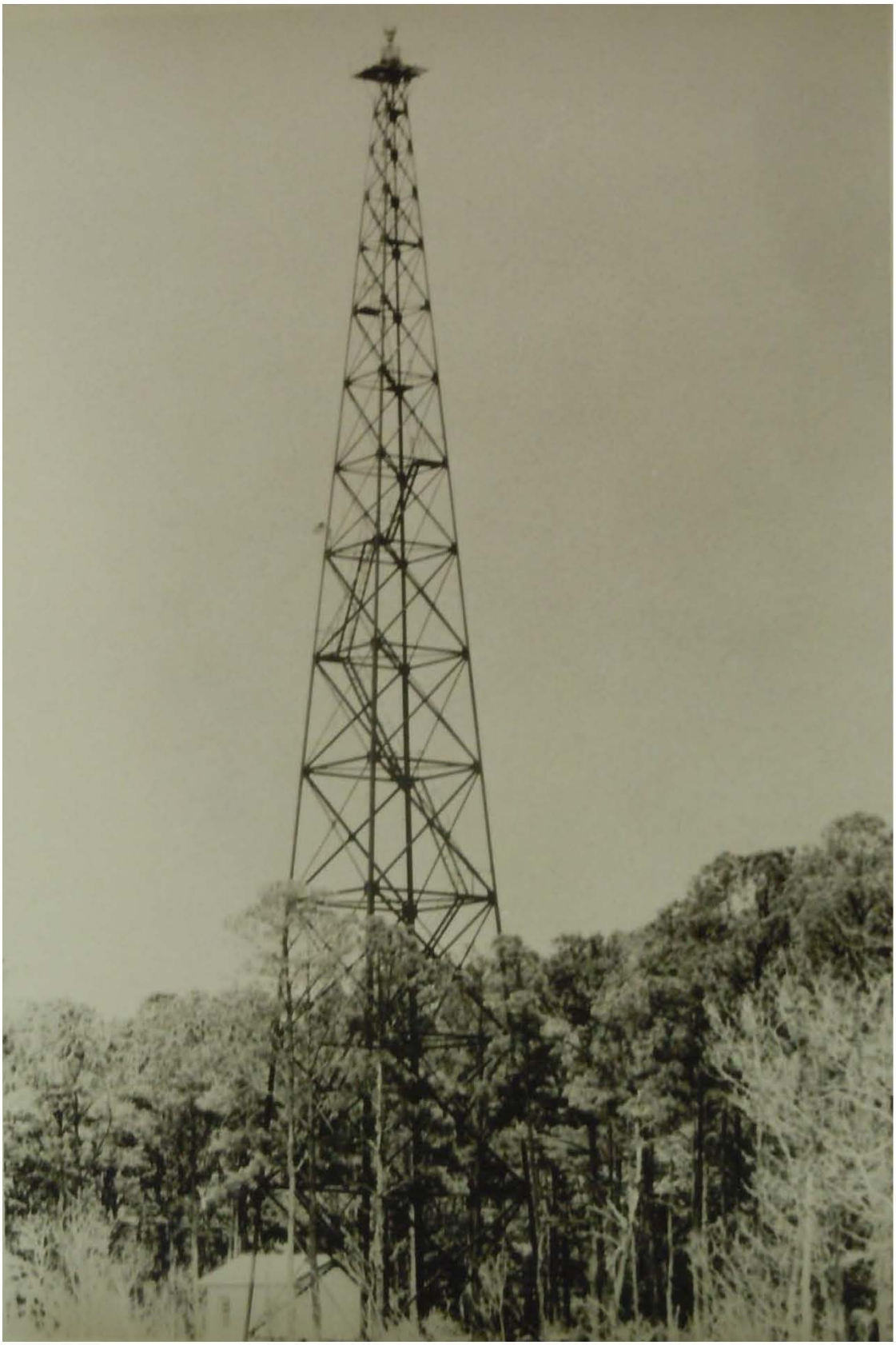
"8. C. S. 2. CAPE HATTERAS LT.STA., N.C. MAY 30, 1893."
Cape Hatteras National Seashore Archives, Cape Hatteras Light Station Photos, Box 1 of 6, Cape Hatteras Lighthouse A

"9.C.S.7. CAPE HATTERAS LT.STA., N.C. JUNE 1, 1893."
Cape Hatteras National Seashore Archives, Cape Hatteras Light Station Photos, Box 1 of 6, Cape Hatteras Lighthouse A

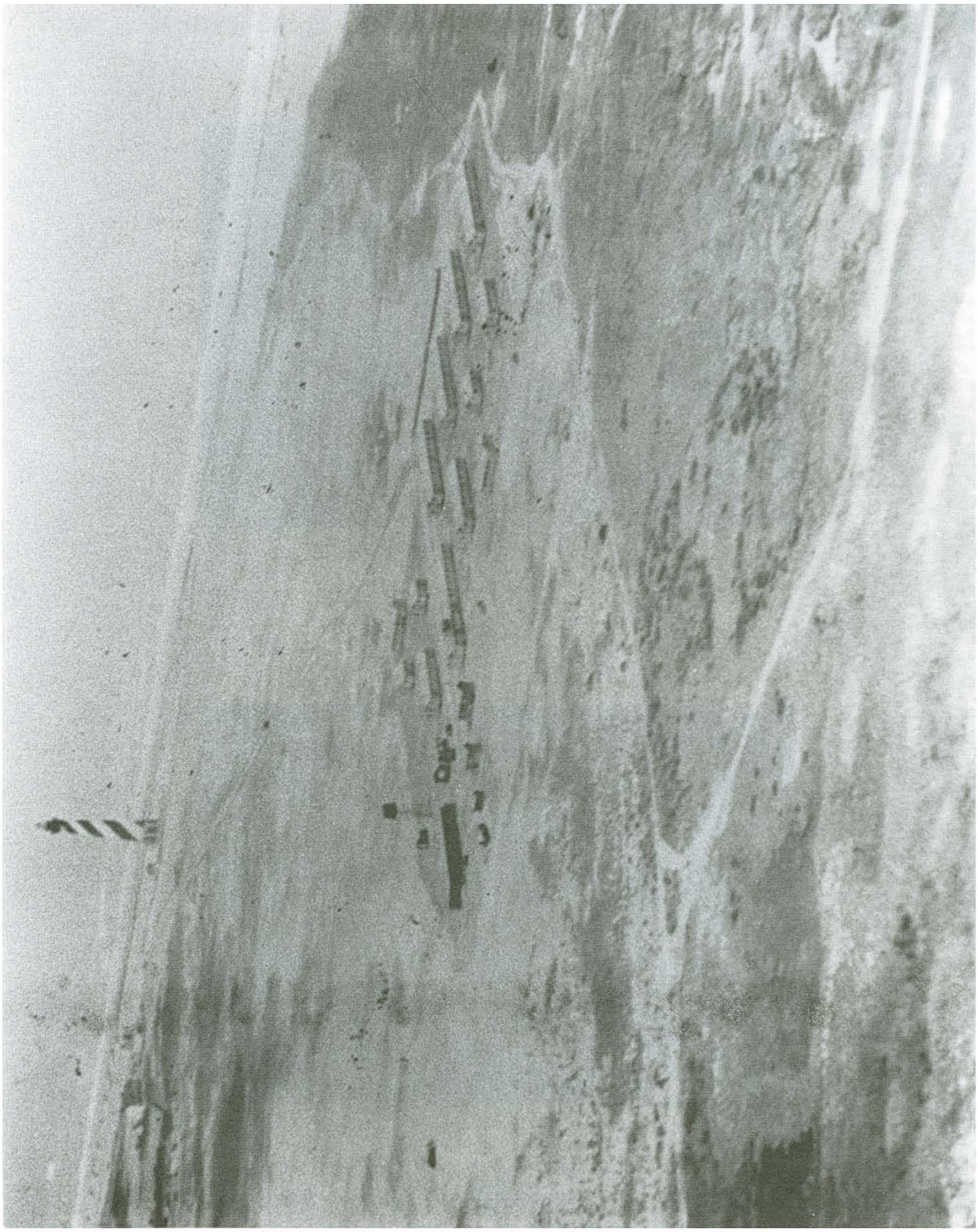
Cape Hatteras National Seashore Archives, Cape Hatteras Light Station Photos, Box 1 of 6, Cape Hatteras Lighthouse A

Cape Hatteras National Seashore Archives, Cape Hatteras Light Station Photos, Box 2 of 6, Cape Hatteras Lighthouse B

Cape Hatteras National Seashore Archives, Cape Hatteras Light Station Photos, Box 2 of 6, Cape Hatteras Lighthouse B



Cape Hatteras National Seashore Archives, Cape Hatteras Light Station Photos, Box 5 of 6, Miscellaneous



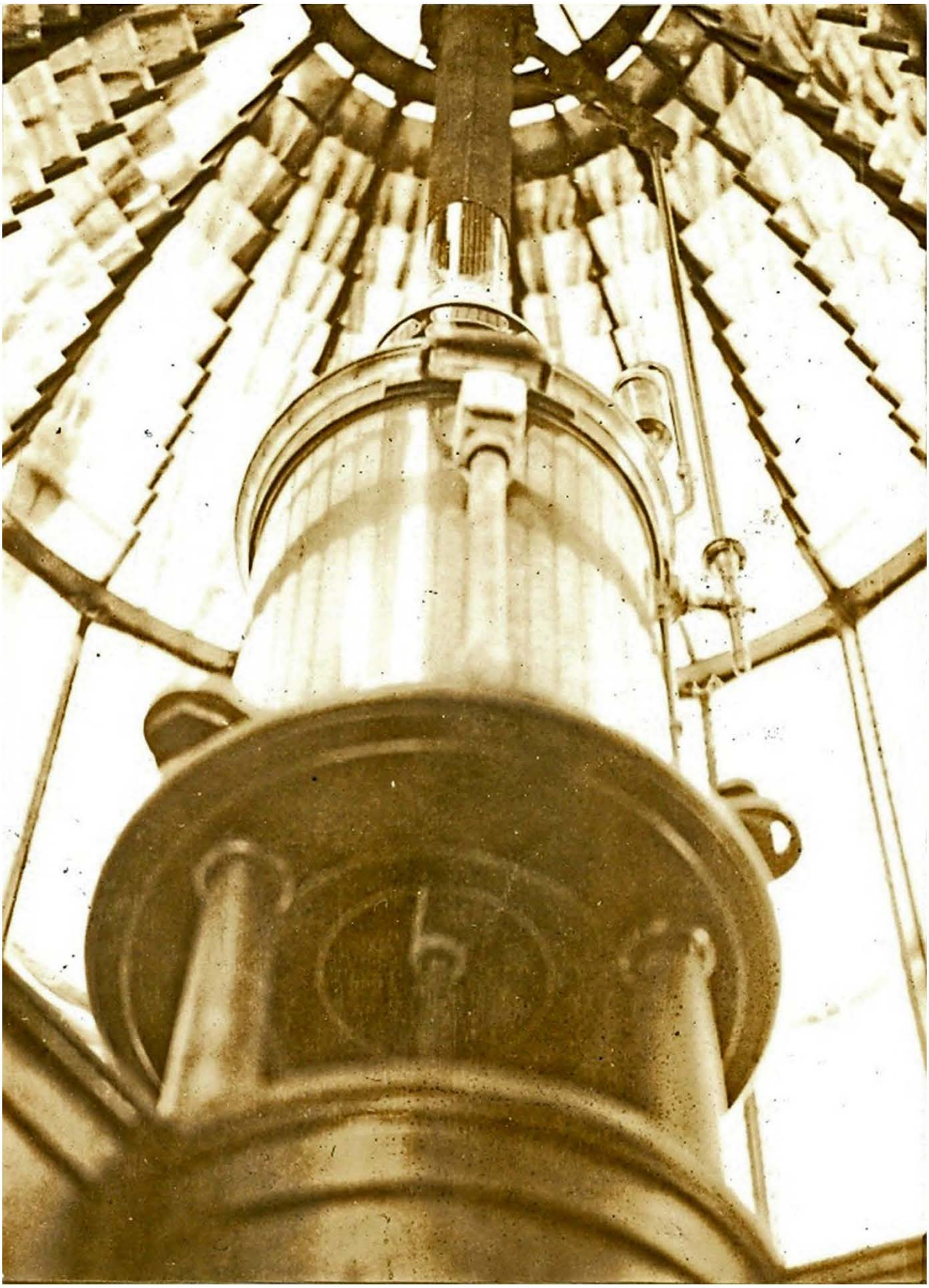
Cape Hatteras National Seashore Archives, John Havel's Photos

Cape Hatteras National Seashore Archives, Cape Hatteras Light Station Photos, Box 1 of 6, Cape Hatteras Lighthouse A

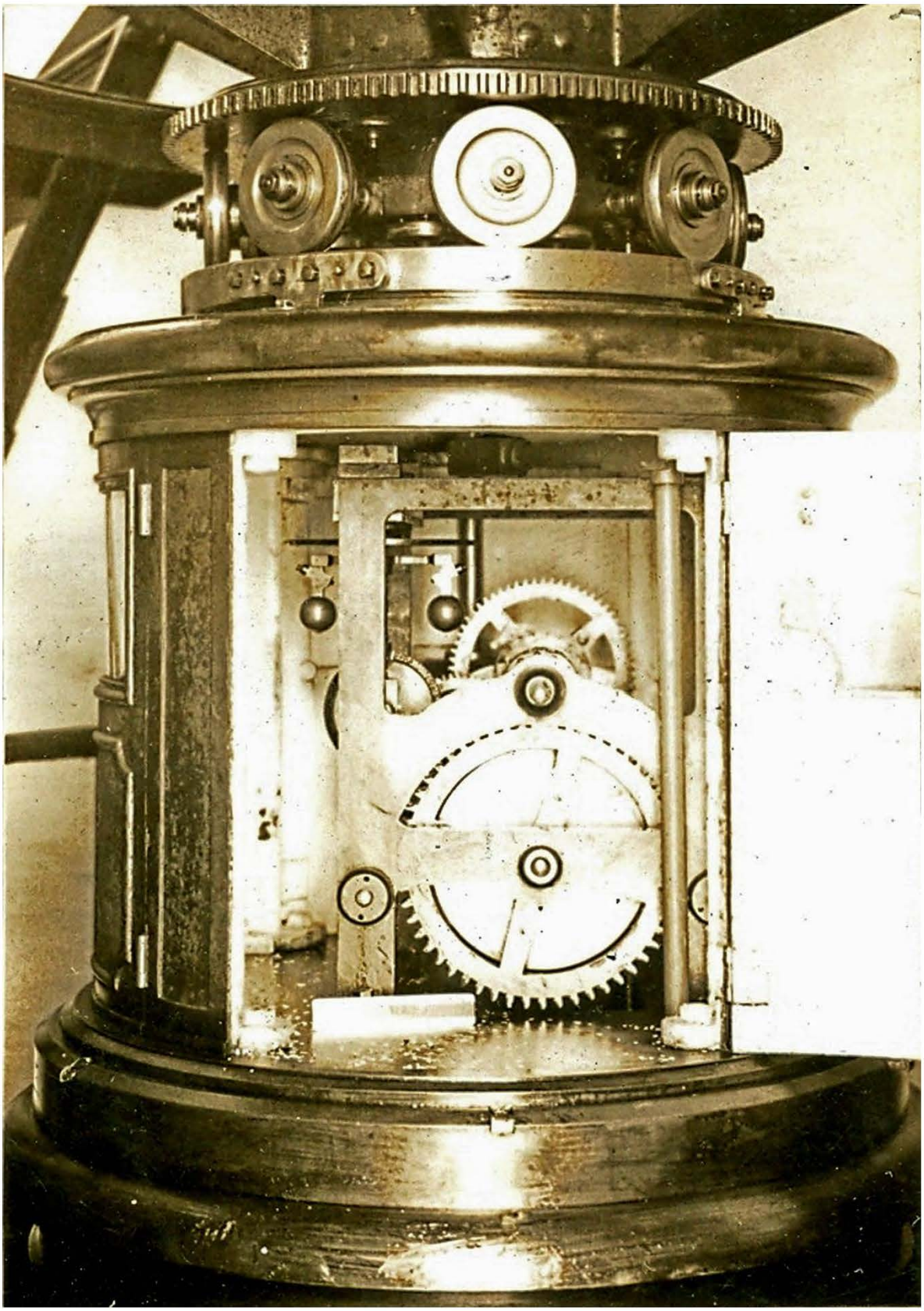
Cape Hatteras National Seashore Archives, John Havel's Photos, Photos from 1937 Porter Report

Cape Hatteras National Seashore Archives, John Havel's Photos, Photos from 1937 Porter Report

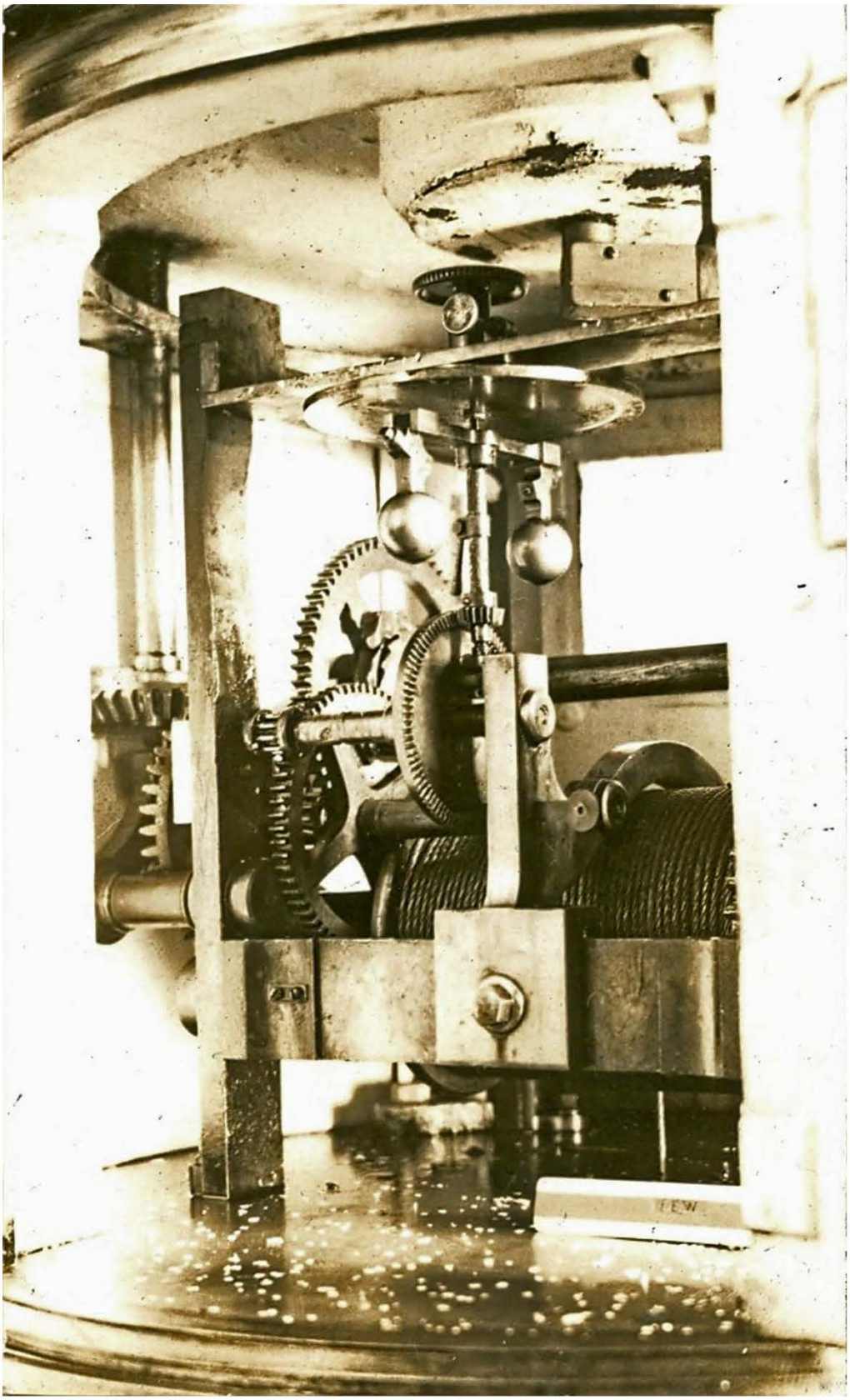
Cape Hatteras National Seashore Archives, John Havel's Photos, Photos from 1937 Porter Report



Cape Hatteras National Seashore Archives, John Havel's Photos, Photos from 1937 Porter Report



Cape Hatteras National Seashore Archives, John Havel's Photos, Photos from 1937 Porter Report



Cape Hatteras National Seashore Archives, John Havel's Photos, Photos from 1937 Porter Report

"5/8/1948 Lighthouse from yard of hotel Elbert Cox photo"
Cape Hatteras National Seashore Archives, John Havel's Photos

Cape Hatteras National Seashore Archives, Cape Hatteras Light Station Photos, Box 2 of 6, Cape Hatteras Lighthouse B

"Duplex lens assembly at Cape Hatteras Lighthouse" 6/22/56
Cape Hatteras National Seashore Archives, John Havel's Photos

Cape Hatteras National Seashore Archives, Cape Hatteras Light Station Photos, Box 1 of 6, Cape Hatteras Lighthouse A

"District Naturalist Gifford gives tour" July 1963
Cape Hatteras National Seashore Archives, Cape Hatteras Light Station Photos, Box 1 of 6, Cape Hatteras Lighthouse A

"Trash Collections Kickoff, Thursday, August 1, 1965"
Cape Hatteras National Seashore Archives, Cape Hatteras Light Station Photos, Box 1 of 6, Cape Hatteras Lighthouse A

Cape Hatteras National Seashore Archives, Cape Hatteras Light Station Photos, Box 1 of 6, Cape Hatteras Lighthouse A

06/15/1979
Cape Hatteras National Seashore Archives, John Havel's photos

"Unaka Jennette, National Geographic, Dec. 1933-issue, April 1933-taken."
Cape Hatteras National Seashore Archives, Cape Hatteras Light Station Photos, Box 5 of 6

"Looking through the entrance at Cape H. Light." 10/6/55
Cape Hatteras National Seashore Archives, John Havel's Photos

"Lighthouse Painting (Interior) - 1960
Cape Hatteras National Seashore Archives, Cape Hatteras Light Station Photos, Box 1 of 6, Cape Hatteras Lighthouse A

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Appendix D

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Appendix D: Archival Drawings

The following archival drawing files are provided on the enclosed CD and are not printed for this document to conserve paper. The following drawings are listing in chronological order.

- U.S. Department of the Interior. National Park Service. "General Development Plan, Part of the Master Plan, Cape Hatteras National Seashore." *1 Sheet.* January 1939. NPS DSC eTIC No. CAHA 603 2060.
- United States Department of the Interior, National Park Service, Branch of Engineering, Regional Office. "Beach Erosion, Point of Cape Hatteras, North Carolina, Cape Hatteras National Seashore." *1 Sheet.* February 1939. NPS DSC eTIC No. CAHA 603 5300 Z1.
- United States Department of the Interior, National Park Service, Branch of Plans & Design, Regional Office. "Property Map, Hatteras Section, Cape Hatteras National Seashore Recreational Area." *1 Sheet.* December 9, 1941. NPS DSC eTIC No. CAHA 603 2018.
- Department of the Interior, National Park Service. "Cape Hatteras National Seashore Recreation Are Project, North Carolina." *1 Sheet.* October 27, 1952. NPS DSC eTIC No. CAHA 603 7017B.
- United States Department of the Interior, National Park Service, Division of Design & Construction, Eastern Office. "Development of Cape Hatteras Lighthouse Area, Part of the Master Plan, Cape Hatteras Nat'l Seashore Recreational Area." *1 Sheet.* August 25, 1955. NPS DSC eTIC No. CAHA 603 3025.
- US Army Corps of Engineers, Wilmington District. "Lighthouse Protection Project, Cape Hatteras Lighthouse, Cape Hatteras, NC." *27 Sheets.* August 29, 1986. NPS DSC eTIC No. CAHA 603 41907.
- United States Department of the Interior, National Park Service. "Preservation of Cape Hatteras Lighthouse, Cape Hatteras National Seashore, North Carolina." *19 Sheets*. March 10, 1988. NPS DSC eTIC No. CAHA 603 80020.
- U.S. Army Engineer District, Corps of Engineers, Wilmington, North Carolina. "Cape Hatteras Lighthouse, North Carolina, South Groin Rehabilitation." *4 Sheets.* April 13, 1994. NPS DSC eTIC No. CAHA 603 80052.
- United States Department of the Interior, National park Service, Denver Service Center. "Lighthouse Move Phase II, Cape Hatteras Lighthouse, Cape Hatteras National Seashore." *8 Sheets.* September 4, 1997. NPS DSC eTIC No. CAHA 603 41024.
- United States Department of the Interior, National park Service, Denver Service Center. "Existing Conditions/Proposed Building Relocation, Cape Hatteras Light Station, Cape Hatteras National Seashore." *Solicitation Set. 4 Sheets.* March 10, 1998. NPS DSC eTIC No. CAHA 603 25005.
- United States Department of the Interior, National park Service, Denver Service Center. "Relocate the Cape Hatteras Light Station, Cape Hatteras Light Station, Cape Hatteras National Seashore." *Final Construction Documents. 42 Sheets.* June 1999. NPS DSC eTIC No. CAHA 603 25006A.
- United States Department of the Interior, National park Service, Denver Service Center. "Relocate the Cape Hatteras Light Station, Cape Hatteras Light Station, Cape Hatteras National Seashore." *Project Record Drawings. 58 Sheets.* June 1999. NPS DSC eTIC No. CAHA 603 25006A. December 23, 1999.

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Appendix E

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Appendix E: 1968 History of Cape Hatteras Light Station

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 Park Service, U.S. Department of the Interior. September 30, 1968.

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A HISTORY OF THE CAPE HATTERAS LIGHT STATION

Cape Hatteras National Seashore, N. Car.

By F. ROSS HOLLAND, JR.

DIVISION OF HISTORY

Office Of Archeology and Historic Preservation

September 30, 1968

National Park Service U.S. Department of the Interior

PREFACE

This study of the history of the Cape Hatteras Light Station is an outgrowth of RSP CAHA-H-2 Historic Structures Report, Part I, Keepers Quarters, Cape Hatteras. It was decided to complete research on the whole light station rather than just one structure, because: (1) the park has little information on the history of that light station, and, after all, the Cape Hatteras tower is the park's symbol, and (2) it does not greatly increase the effort to extract all information on a particular light station than it does to get information on one aspect, or structure, of the station.

In the course of research it was also found that brief histories of other aids to navigation in the area could be included with little extra expenditure of time or money. Hence, histories of the Diamond Shoals Lightship, the Cape Hatteras Beacon, the Hatteras Inlet Light, and the Shell Castle Beacon can be found in this report. These histories are not to be considered definitive ones for the individual aids. Considerably more information exists on them in the National Archives and elsewhere.

I want to thank especially Mrs. Faith Holdcamper of the National Archives who, as always, was most cheerful and helpful in helping me locate the pertinent records in the Archives. Also, my thanks to Miss Dorothy Junkin for her thorough and meticulous care in typing this report.

F. R. Holland, Jr.

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CAPE HATTERAS LIGHT STATION

INTRODUCTION

Not long after settling the New World the Spaniards found that it speeded the journey of their ships to come out of the Caribbean and follow the Gulf Stream northward to the general area of Cape Hatteras where they jumped off to Europe, for beyond this point the stream breaks up into streaky, ill-defined currents. South of Hatteras this "river in the sea," flowing in places at a maximum rate of over four knots, cut weeks off the Spaniards' homeward journey.

The Gulf Stream is well off-shore for most of its journey and between it and the shore is a cold counter-current from the north. Mariners were not long in learning that one followed the in-shore current when heading south, and when traveling north one got farther out where the Gulf Stream was. The chief danger was to the southbound traffic, and that danger lay in getting past Cape Hatteras. Here the land and its attendant shoals jut out into the ocean and the stronger and warmer Gulf Stream, in effect, pinches down the colder shore-current close to these shoals, leaving only a relatively narrow passage for shipping traffic bound southward. With but a few miles between the shoals and the Gulf Stream, the navigator had to be pretty accurate in plotting a course to pass safely this dangerous

area. If he were off a few degrees in one direction, the ship might end up on the shoals and if he were off a few in the other direction, the ship would have to fight a strong current running against it. Moreover, getting into the Gulf Stream could be an unnerving experience, as one captain long engaged in the coasting trade recounted:

> Had a run to Cape Hatteras. Here a heavy northwester hit me and blowed my spanker away. It blew a heavy gale and sail I could not hold the beach and I drifted ever so far offshore into the Gulf Stream. This cold air on this warm water made the ghostliest sight I ever laid my eyes on before. For miles, before getting into the warm water on the Stream, it would seem I saw thousands of water spouts. Then it would look like forestry. This would pass off for a minute. Then next I see some great city and to be honest I felt scared. After a while I drifted out of the cold water into the warm water and then I was enclosed into this vapor and I could see nothing but cities, towns, forestry, and ships of all kind of rigs. And this was all vapor rising off this warm water. Sometimes the sailors would squeal out, “There is a ship on the port.” I would jump forward to get the bearing of her and about that time she would disappear [sic] and roll away as nothing but mist. Now I was lying right in the track of ships from New York or Philadelphia bound south. All that night I never shut my eyes in sleep and none of the crew got much. I expected every moment to be runed [sic] over. All day the next day, the wind continuing to blow a gale from the northwest, we continued to see these phantom ships, cities, forestry, and water spouts.[1]

1. Robert H. Burgess, ed., C*oasting Captain: Journals of Captain Leonard S. Tawes Relating His Career in Atlantic Coast-wise Sailing craft from l868-l922* (Newport News, Va.: The Mariners Museum, 1967), p. 83.

Natural landmarks to assist the navigator along this stretch of coast were, and still are, virtually unavailable. The Outer Banks of North Carolina are low-lying strips of sand and beyond them is a wide expanse of water. Consequently, unless he sailed very close to the shore, the navigator had no significant landmark he could use to determine his position.

Through the colonial period and for a number of years into the new government nothing was done to aid the mariner in getting past this ever-present and exceptionally dangerous area. Finally in the waning years of the 18th century the Federal Government took action and provided for a lighthouse at Cape Hatteras. The purpose of this aid to navigation was not simply to get vessels safely past Cape Hatteras, but to get them safely past the Diamond Shoals, which, of course, was the real area of danger to the seaman. Almost from the beginning the Federal Government had a desire to build a lighthouse at the end of Diamond Shoals, but until very recent years technology had not really progressed far enough to erect such a structure on this stormy area which had so insecure a bottom.

Running through the history of the Cape Hatteras Lighthouse is this theme of getting some sort of navigational aid into the ocean at the tip of Diamond Shoals. Although the government tried various methods, including using lightships and buoys, it did not achieve the

final solution to light the shoals until January 1967 when for the first time the Coast Guard lighted a Texas tower-type lighthouse at the end of Diamond Shoals. Thus the story of the Cape Hatteras light is more than the establishment of a brick tower at a prominent point of land. This is the story of all the aids to navigation man has provided in order to make a safe passage by one of the most dangerous areas of shoals in the United States--a story that embraces lightships, buoys, lighthouses, and light towers in the ocean.

CAPE HATTERAS LIGHT STATION—THE BEGINNING

Congressional provision to build a lighthouse at Cape Hatteras, strangely enough, resulted from the agitation for a beacon at a less significant point on the Outer Banks. In 1794 the United States Senate instructed the Treasury Department to look into the feasibility of erecting a lighthouse at Ocracoke Inlet. At that time the Department took the opportunity to look at the North Carolina coast as a whole to determine the aids to navigation needed there. When the study was finished, Tench Coxe, then Commissioner of Revenue and consequently responsible for the country's aids to navigation, reported that most of those engaged in maritime activities in North Carolina wanted a light at Cape Hatteras. A light there, he said, would be beneficial to far more people, in view of the increasing coastwise traffic, than would a light at Ocracoke which would avail only those traders who used that inlet to enter the sounds of North Carolina. In consequence of this thinking, Coxe recommended that a full-scale lighthouse be placed at Cape Hatteras and a small wooden beacon at Ocracoke. The Secretary of the Treasury, Alexander Hamilton, concurred in the recommendation of the lighthouse for Cape Hatteras. As a result, in April 1794 Congress authorized not only the erection

of a beacon on Shell Castle Island at Ocracoke but also, and more important nationally, a lighthouse at Cape Hatteras.[2]

With the passage of this act, nearly ten years were to go wafting by before a light shone at these two places. The principal problem was locating a builder who would undertake the contract for the two lighthouses.

A minor holdup occurred shortly after the aids to navigation were authorized when the North Carolina legislature ceded jurisdiction over land at Cape Hatteras and Beacon Island for lighthouse purposes at Ocracoke Inlet. There was a delay of a little over 6 months before the legislature got around to remedying the situation by ceding jurisdiction over a small piece of land on Shell Castle Island in place of Beacon Island. With this problem out of the way the Federal Government then went about acquiring the land necessary for the two light stations. On November 29, 1797, John G. Blount and John Wallace, owners of Shell Castle, sold to

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2. American State Papers. Class IV, v. I, Commerce and Navigation, 1st-13th Congress, 1789-1815 (Washington: 1832), pp. 265-267, 299. At this time, and for many years afterwards, lighthouse keeper positions were considered choice. Cape Hatteras was no exception. Within a few days of passage of the act authorizing the Cape Hatteras and Shell Castle lighthouses the congressman from that district wrote the Secretary of the Treasury recommending that Adam Gaskin, who was a state legislator from Carteret County, be appointed keeper of the Cape Hatteras light upon its completion. See B. Williams to Alexander Hamilton, Federal Hall, May 8, 1794, in Bureau of Lighthouses, Letters Received. V. A. 1789-1795, R. G. 26; National Archives.

the Government for $200 a lot 70' x 140' on the island and stipulated that the government "shall not permit goods to be stored, a Tavern to be kept, spirits to be retailed or Merchandise to be carried on, on said Lott." Then a year later, on October 26, 1798, the Government purchased 4 acres of land at Cape Hatteras for $50. It acquired the land from Christian Jennett, Thomas Farrow, and Joseph Farrow.[3]

In the meantime the Government, in a somewhat bumbling fashion, attempted to locate a contractor willing to undertake the building of both lighthouses. Local North Carolina people evinced no interest in the contract, principally, so the local Collector of Customs reported, because their money could be employed more "advantageously in Commerce of Agriculture and of course no one has a surplusage to tempt him into more arduous and less profitable enterprises. Tench Coxe had handbills posted in various government offices from Maine to North Carolina and instructed the collectors in North Carolina, Virginia , Maryland, New York, Connecticut, and Massachusetts to advertise in local newspapers for bidders. As a result he received bids from several sources. One bid came from an "English workman" who offered to build the Cape Hatteras light

3. Lighthouse Deeds and Contracts, v. A, 1790-1806, pp. 220-222; Lighthouse Letters, 1792-1798, v. I, p. 75; Lighthouse Letters, May 20, 1822-February 28, 1826, pp. 260-263, all in Record Group 26.

for $32,000 and the Shell Castle light for $16,000. But Coxe considered the bid "dishonest and impudent" and filled with "misconceptions and misinterpretations." If that bid startled him, Coxe must have really been shocked when David Hampton bid $64,528.93 to erect just the Cape Hatteras light. Not long afterwards Coxe wrote John McComb, a brickmason who built the Montauk Point and the Cape Henry lighthouses, agreeing to pay him $37,500 to construct the Cape Hatteras light alone. The offer satisfied McComb, but, in time, this effort, as well as one to elicit a bid from Thomas and John Gray Blount of North Carolina, bore no fruit.[4]

In the meantime complications began to arise. The cession of land by the State of North Carolina to the Federal Government had a 3-year limitation and it expired in 1797. At about the same time an appropriation for building the lighthouse expired. Ironically enough, all of this occurred just as Coxe came to terms with John McComb to build the Cape Hatteras lighthouse.[5]

Coxe, in effect, had to begin all over again. He contacted the North Carolina delegation to have them see to getting a new

4. Thomas Blount to Tench Coxe, December 18, 1795, Letters from L. H. Superintendents, Box 10,; Lighthouse Letters, 1792-1798, v.I., pp. 236, 328, 348, 386, 402, 405-408, 494; Letters Received, v. 0, 1796-1803, pp. 15, 273; all in R. G. 26.

5. Lighthouse Letters, 1792-1798, v. 1, pp. 460-462, R. G. 26. All manuscripts cited hereinafter are in the National Archives in Record Group 26.

act of cession. The delegation apparently did its part, for in December 1797 the North Carolina legislature renewed the cession to the land at Cape Hatteras. Previously, in July 1797, Congress had appropriated $44,000 for the lights at Cape Hatteras and Shell Castle. All Coxe now needed was a contractor, and in July a fish began nibbling at the Commissioner of Revenue's hook.

In July, Henry Dearborn, who had just completed his second term as a Congressman from Massachusetts congressmen, wrote that he might be interested in contracting to build the Cape Hatteras and Shell Castle lighthouses. Coxe immediately replied, encouraging Dearborn to make a bid. Not long afterwards Dearborn did bid and in the latter part of September his bid, with two others, was forwarded to President John Adams for approval. Coxe felt Dearborn's would be the successful bid. He was so confident that Dearborn's proposal would receive acceptance that he ordered the Collector of Customs in Edenton to purchase land for the two lighthouses.[6]

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6. Lighthouse Letters, 1792-1798, v. 1 pp. 463-464, 474, 490-491, 492-494; Clipping File, Cape Hatteras. The land wanted for the Cape Hatteras light was owned by four minor children, William, Mary, Jabez, and Aquilla Jennett. North Carolina laws required that the legislature did not take the required action until about January 1801. The deed conveying the land to the Government is dated in 1801. Meanwhile construction had already begun on the light station. The children received $50 for the four acres. See Lighthouse Deeds and Contracts,

But at this juncture Tench Coxe was removed as Commissioner of Revenue, and before President Adams took action on the contract with Dearborn. Coxe's successor, William Miller, Jr., had ideas of his own about the contract. He felt it was vague on charges for transportation, amount of stone needed, and the nature of the foundation. And this vagueness, he contended, favored the contractor. In February 1798 Adams disapproved the contract on Miller's recommendation, and Miller wrote Dearborn offering to draw-up a new contract with more definite wording and the vagueness eliminated. Right afterwards Miller also wrote McComb saying that the contract for the Cape Hatteras light was still open and suggesting that he might like to make a bid. But apparently McComb was not interested, and bargaining continued between Miller and Dearborn. In the meantime, however, Miller was still looking in other places for a contractor. Sometime during the spring he wrote the Collector in Savannah, Georgia, asking if any likely prospects were in that city. None were. Finally in the fall of 1798 Dearborn submitted a proposal that the President accepted, and on October 9, 1798, Miller forwarded

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v. A. 1790-1806, pp. 222-225, and Lighthouse Letters, January 29, 1798-September 30, 1802, pp. 267, 301. Henry Dearborn became Secretary of War during the Jefferson Administration and later Collector of Customs for the port of Boston. During the War of 1812 Madison appointed him senior Major General of the Army, and after the War he became Minister to Portugal. *Dictionary of American Biography* (New York: Charles Scribner's Sons, 1943). v. V, pp. 175-176.

to Dearborn articles of agreement to sign, which Dearborn did, apparently on October 31, 1798.[7]

THE SITE AND THE STRUCTURE

The site selected for the Shell Castle lighthouse was a small lot on the eastern end of the island with "Seventy feet fronting the north side of Wallace Channel and running northward One hundred &forty feet…." The site for the Cape Hatteras light consisted of 4 acres for which the Collector of Customs paid $50. Of the site the Collector said: "The hill on which the Light House will stand is at present well covered with Live Oak and other Trees, and it would be well to direct the Builder to cut as few of them off as possible particularly on the declivity of it--the Trees if left standing will prevent [?] the ground from washing."

According to the proposal Dearborn submitted and President John Adams approved, the Shell Castle light station was to consist of a wooden, octagonal beacon tower, 64 feet tall (including lantern), a wooden dwelling, and an oil vault and shed. The Cape Hatteras station was to contain a stone and brick octagonal tower

7. Lighthouse Letters, January 29, 1798-September 30, 1802, pp. 4-7, 12, 15, 16, 67; Lighthouse Deeds and Contracts, v. A, 1790-1806, p. 106; Lighthouses, Letters Received, v. D., 1796-1803, p. 25.

90 feet tall plus a twelve-foot lantern, an oil vault and shed, and a two-story frame dwelling 34 feet by 16 feet.[8]

BUILDING THE LIGHTHOUSE

Even though a representative of the Federal Government did not sign the contract until February 14, 1799, thus making the whole transaction official, Dearborn nevertheless moved right along with plans to begin the work. Dearborn requested and received in the latter part of November 1798 an advance of $8,000 to buy materials. By late spring he was ready to begin transporting the materials to the Outer Banks, but delays occurred, and he did not get underway until August. His ship had barely gotten out of port when an accident to it forced him to pull into Boston for refitting. This work did not take long, and toward the end of August Dearborn and his materials arrived at Shell Castle. After pausing briefly there, he then journeyed to Cape Hatteras and built the keeper's quarters. Leaving men there to work on the tower, he returned to Shell Castle where he met Samuel Tredwell, the Collector in Edenton, whom the Commissioner of Revenue had instructed to oversee the work

8. Samuel Tredwell to William Miller, Edenton, November 2 and 25, 1798, Letters from Light House Superintendents, Box 10; Lighthouse Deeds and Contracts, v. A, 1790-1806, pp. 72-75.

of the contractor. Tredwell pointed out to Dearborn the site of the Shell Castle beacon.[9]

The work on the two lighthouses had progressed so well by October that Commissioner Miller recommended that Dearborn receive a first payment of $2,000. And two months later work had advanced so that Miller recommended a further payment of $4,000. Progress on the two light stations evidently ceased about this time, probably due to the approach of winter, and Dearborn and his crew left the Outer Banks.

The following March, Dearborn collected another crew and headed south, and immediately began work on the foundation for the Cape Hatteras light. By May the workmen had sunk a hole 8½ feet below the surface and had laid the first course of stone for the tower's base. By the first week in July two inspectors certified to the Collector that the tower "is raised twelve feet above the bottom of the water table, &...the flooring for the bottom of the second story is laid…." This progress prompted Commissioner Miller to urge payment of $2,500 to Dearborn, which brought the total paid to him at this point to $18,500, close to half the contract price.

9. Samuel Tredwell to William Miller, Edenton, August 31 and September 21, 1799, Letters from Lighthouse Superintendents, Box 10; Lighthouse Letters, January 29, 1798-September 30, 1802, pp. 71, 75, 76, 87, 110, 111, 126.

At about this time serious problems struck Dearborn. A sickness overcame his workmen and before July ended 13 of his crew had become ill and one had died. Dearborn himself departed the scene, and he left Dudley Hobart in charge. Hobart apparently stuck it out for a while, but at least by the fall he had sent his men home "to recoup their health." By this time the workmen had erected Shell Castle beacon, and it lacked only the lantern to be complete. The keeper's house was nearing completion. Work, however, had not progressed as far on the Cape Hatteras station. The keeper's house had been finished and a well dug, but the tower was far from being completed. The Collector reported progress on the tower as follows:

> The Foundation of the Light House at the cape has been sunk 9 feet below the water Table (or surface of the Earth) is commenced 29 feet in diameter, to the height of 4 feet from the commencement is solid and from thence to the water Table the Wall is 9 feet thick, and the first story is raised 12 feet from the bottom of the water Table to the top of the Beams. The outside is laid with hammer dressed Stone 10 inches thick and from 1 to 4 feet long, of a firm and durable kind.[10]

It is interesting to compare this statement with the report of an examination of the tower in 1869. The report was made by the

10. Samuel Tredwell to William Miller, Edenton, May 31, 1800, and July 9, 1800, Letters from Light House Superintendents, Box 10; Lighthouse Letters, January 29, 1798-September 30, 1802, pp. 143, 158, 170, 178, 199, 207, 232, 233; Lighthouse Board, 5th District Engineer Letter Press, 1867-1869, pp. 681-682.

Superintendent of Construction on the second tower and it read:

> ...Foundation of old Light House 9 feet deep from top of base of tower; built of slate stone varying in thickness from 2 to 6 inches; put up with lime mortar and only one foot larger at bottom of foundation than at base of foot.
>
> ...Diameter at base of tower 26'6". Walls 5'6" thick.
>
> ...The lime mortar very soft and stones of foundation laid on the sand with no timber under them.

As of July the Government had advanced Dearborn $18,500, and in October he asked for another $4,000 to $6,000. Because of the problems Dearborn had, Commissioner Miller was sympathetic to his contract, and passed on the request to the Secretary of the Treasury for his judgment. The Secretary decided to advance Dearborn $4,000, but this sum apparently did not satisfy his needs, for in December Dearborn requested $1,500 more and three months later wanted an additional $3,000. Commissioner Miller recommended advancing the money Dearborn asked for because of the "peculiar difficulties" he had faced. By October 1801 the Government had advanced Dearborn $30,200 of the $38,450 contract, and Dearborn was far from having the work completed.

Dearborn's crew resumed work on the Cape Hatteras station in the spring of 1801 and worked until August 1 when they departed,

11. Lighthouse Letters, January 29, 1798-September 30, 1802, pp. 233, 234, 260, 291, 328.

probably again due to sickness. Work was not resumed until the spring of 1802. By now the work was nearing completion, and in June Dudley Hobart, Dearborn's representative at the site, reported that the masons had completed the stonework, and all now needed were the lanterns for the two lighthouses. Hobart estimated that Cape Hatteras and Shell Castle would be ready for lighting by the middle of July, which, as it turned out, was a gross overestimation. In August Hobart reported the two lighthouses as completed, 'but for some reason the lighting of them did not occur. By June 28, 1803, the lighting, or the "raising of the light" as it was termed then, had not happened. The reason for the delay is not known at present, but the local newspapers expressed dissatisfaction with the delay. Just when the lights were "raised" is not known, but both lights were in operation before October 29, 1803.[12]

In the meantime Dearborn agreed, for the consideration of an additional $1,200, to build up the foundation of the Shell Castle station "By running an outside wall at the distance of 12 feet from the foundation of the Buildings 2 feet high, between the wall and

12. Lighthouse Letters, January 29, 1798-September 30, 1802, pp. 401, 402, 456, 518, 532, 533; Lighthouse Letters, October 1, 1802-September 27, 1809, pp. 5, 70, 78, 79, 122, 123, 126-128; Samuel Tredwell to William Miller, Edenton, August 23, 1802, and October 29, 1803, Letters from Lighthouse Superintendents, Box 10; Bureau of Lighthouses, Letters Received, v. D, 1796-1803, p. 465.

the foundation, a solid bed of stone was to have been laid gradually rising towards the center so as to cover the foundation, and to extend as high as where the wood work of the Beacon and Dwelling commences." With this addition, Dearborn's contract for building the two lighthouses now totaled $39,650. Meanwhile, Dearborn continued to draw advances on the total contract and by the fall of 1803 he had obtained $39,300. He applied to the Commissioner for the remaining sum, but the Commissioner recommended against payment, contending that the contract was not satisfactorily fulfilled; some minor work needed to be done at both structures and the foundation at Shell Castle needed additional stone. It is not known whether the work was done, but the claim was not settled immediately, being finally settled on May 6, 1824, when the account was sent to the auditor for adjustment. At any rate Dearborn's reputation was not injured for he went on the next year to become Secretary of War, and about six years later contracted for and erected the lighthouse on Plumb Island as well as two Beacons in Ipswich Harbor.[13]

THE FIRST KEEPERS

As the two lighthouses on North Carolina's Outer Banks neared completion the question of keepers to man them arose. Dearborn and

13. Lighthouse Letters, October 1, 1802-September 27, 1809, pp. 5, 21, 46, 126-128~ Lighthouse Letters, October 6, 1809-May 24, 1817, p. 15; Lighthouse Letters, May 20, 1822-February 28, 1826, p. 257.

his agent, Hobart, recommended Thomas Farrow and John Mays. They felt Mays would De Detter suited for the Cape Hatteras light because he had a "tolerable good" education and desired to open a school in the vicinity of the Cape. But the Collector of Customs, Samuel Tredwell, had another man in mind for Cape Hatteras, and that was Adam Gaskin, the man the North Carolina congressman had recommended at the time the lighthouse was first authorized; Gaskin, undoubtedly, was a good party man.

In the autumn of 1802 the President appointed Adam Gaskin keeper of the Cape Hatteras light and John Mays keeper of the one on Shell Castle Island. Gaskin, who assumed his duties officially on December 29, 1802, was to receive $333 per year as salary, which was the same that the Cape Henry keeper received. Mays was to be paid $250 per year. This salary, however, did not appeal to Mays and he declined he appointment.

In searching about for a replacement Tredwe1l reported that John Wallace, one of the owners of the island, would accept the job for the same salary as that paid the Cape Hatteras keeper. Shortly afterwards Wallace received his appointment, and he accepted, but as it turned out he undertook the job with a misunderstanding about the salary. Tredwe1l later said he had made it clear to Wallace that the salary would be $250. Wallace, on the other hand, stated that he understood his salary would be $333, and he claimed that

amount a year later. Albert Gallatin, by now Secretary of the Treasury, gave Wallace the benefit of the doubt and allowed him at the rate of $333, but informed Wallace that henceforth he would be paid $250 per year. Wallace became unhappy at this turn of events and shortly afterwards wrote Tredwell that he had stopped lighting the Shell Castle Beacon. Dismayed at this news, Tredwell decided to visit Shell Castle and employ another keeper. He apparently secured the services of John Willard, who remained about a year and was followed by James Taylor.

Meanwhile Tredwell had been more successful with the Cape Hatteras keeper. Gaskin remained on duty until the spring of 1808 when he was succeeded by Joseph Farrow.[14]
Several years later Tredwell recommended that the salary of the keeper at the Shell Castle Beacon be equalized with that of the keeper at Cape Hatteras. He recognized the fact that Shell Castle as a light was not as important, but, he contended, it was a more difficult place to live since the keeper had to bring his wood in

14. Lighthouse Letters, October 1, 1802-September 27, 1809, pp. 6, 47, 155, 437; Samuel Tredwell to William Miller, Edenton, August 23, 1802, and February 16, 1803; Samuel Tredwell to Albert Gallatin, Edenton, June 20 and August 4, 1804, and February 20, 1805; and Albert Gallatin to Commissioner of the Revenue, [Washington], October 8, 1802, in Letters from Lighthouse Supts., Box 10; Bureau of Lighthouses, Letters Received, v. 0, 1796-1803; Lighthouse Accounts, 1804-1811.

by boat and the station property afforded no place where the keeper could grow a garden. Tredwell's plea, however, fell upon deaf ears in Washington, and the keeper's pay continued to be $250 per year. Several years afterwards, on August 16, 1818, the whole question became academic when lightning struck the Shell Castle Beacon, destroying it and the keeper's quarters. It was replaced four years later with the lighthouse now at Ocracoke.[15]

PORPOISE OIL

As the lights at Shell Castle and Cape Hatteras neared completion and preparations were being made to light them, someone proposed using porpoise oil in the lamps of the lighthouses rather than sperm oil as was commonly used in lighthouses of that period. A factor, undoubtedly, in this recommendation was the presence of a supply of porpoise oil. Wallace, one of the owners of Shell Castle Island, had an adequate quantity' on hand and was more than

15. Samuel Tredwell to Samuel Smith, Edenton, July 10, 1816, October 11, 1817, August 27, 1818, and February 13, 1819, Letters from Lighthouse Superintendents, Box 10; U.S. Coast Guard, *Historically Famous Lighthouses* (Washington: G. P. o. 1950), p. 74. The Shell Castle light remained unlighted for a period during the War of 1812. Sometime before September 30, 1813, the British damaged the lantern beyond lighting and there was a delay in getting the necessary repairs made. In the meantime the Collector in Ocracoke decided to suspend indefinitely the relighting of the beacon for fear it would aid enemy

willing to sell it to the lighthouse service. Intrigued with the prospects of porpoise oil being equal to sperm oil in southern latitudes, the Commissioner of Revenue instructed Tredwell to experiment with the use of the oil. In the meantime, the Commissioner had a thousand gallons of sperm oil shipped to the Outer Banks for immediate use at Cape Hatteras and Shell Castle. From the beginning it appears that the experiments with porpoise oil did not go well, but Tredwell continued experiments into 1804 and purchased 158 gallons of the oil for the Cape Hatteras light. In the spring of 1804 Tredwell reported that for about four months the Cape Hatteras light had used virtually nothing but porpoise oil and it seemed to work quite well. The success they had may have been enhanced in their minds by the fact they were having considerable difficulty receiving sperm oil in good condition. Tredwell then approached Wallace to see whether he could supply consistently a sufficient quantity of the oil for the Cape Hatteras light. Wallace, a businessman who believed in obtaining every cent the market would bear for any item, said he would furnish all the porpoise oil needed provided he received a written contract and obtained the same price paid in Nantucket for sperm oil. The contract would have been a tidy one since Cape Hatteras consumed,

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barges in getting over the bar at Ocracoke Inlet. See Samuel Tredwell to Samuel Smith, Edenton, July 16, 1814, Letters from Lighthouse Superintendents, Box 10.

according to estimates, 1,400 gallons of oil annually. The tests thereafter went badly, and the Cape Hatteras light returned to the use of sperm oil only. Several years later one Caleb Ballance, a porpoise-fisher, requested permission to experiment with the use of porpoise oil in lighthouses, but on the basis of the previous unsatisfactory tests at Cape Hatteras, Tredwell recommended against it.[16]

Although in 1810 Tredwell reported that the keeper of the Cape Hatteras light "has made a full Trial of the Porpoise Oil the result of which is altogether unfavorable to the use of it in the Light House," he nevertheless recommended three years later using porpoise oil as an emergency substitute when the ship carrying regular oil for Cape Hatteras was captured by the British *Dash.*[17]

EARLY PROBLEMS

From the beginning the new lighthouse at Cape Hatteras was not wholly satisfactory. Within a year after lighting, it became patently

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16. Lighthouse Letters, October 1, 1802-September 27, 1809, pp. 6, 15, 122-123, 125, 155, 213; Samuel Tredwell to William Miller, Edenton, March 24, 1804; Samuel Tredwell to Albert Gallatin, Edenton, June 20, 1804, July 10, 1804, and July 20, 1809, Letters from Lighthouse Superintendents, Box 10.

17. Simeon Theus to Albert Gallatin, Charleston, May 10, 1813, Early Lighthouse Correspondence, Misc., 1800-1814; Samuel Tredwell to William Jones, Edenton, June 15, 1813, Letters from Lighthouse Superintendents, Box 10.

obvious that the cisterns in the oil vault were too small; consequently, it was necessary to tear up the old ones and dig larger cisterns that held 2,000 gallons. Two years later, on September 2, 1806, a severe gale struck the Outer Banks and so damaged the lantern of the Cape Hatteras tower that the keeper could not display the light. All the boats in the area were affected by the storm and two weeks passed before the keeper could send word to the local superintendent of lights. The light at Cape Hatteras was out for a considerable length of time, for, over a month after the storm, repairs still had not been completed on the light.

Fire struck the lighthouse in January 1809 when "the oil in the Lamp of the Light House at Cape Hatteras by an accident took fire by which means all the Glass in the Lantern was destroyed." There was not enough glass on hand, and in order to make repairs as rapidly as possible the keeper, Joseph Farrow, hired a boat with a crew and journeyed to Washington, North Carolina. As he crossed the sound the wind arose and overturned the 14-ton boat, causing the loss of sails and some of the crew's clothing. Keeper and boat crew managed somehow to obtain a canoe and row to shore. Farrow continued on to Washington to secure the glass. Several days later he and the crew returned and righted the boat. Farrow put

in a claim for the sails and for the righting of the boat. Nearly a year later the Secretary of the Treasury allowed him $86 for all expenses on that trip.

By 1810 the lighthouse was in sore need of maintenance. Not only did the dwelling need reshingling and painting, but the tower was in need of whitewashing. Moreover, new wire for the netting around the lantern to keep birds away was needed, as was a new covering for the oil vault. The two most serious problems, however, were erosion of the base of the tower and fires in the lantern. Of the two, the problem that was to plague the tower the longest and most consistently was erosion. By 1810 the sand hill on which the tower rested had blown away, exposing four feet of the tower foundation. Several people who examined the site suggested filling the sand back in and then paving the area with tar or bricks. Just what action is taken was not known, but the light was kept in operation. It would appear, however, that the area around the base of the light tower was not paved.

The tower's lighting system had become unfit and several fires had occurred in the lantern that were attributable to the lighting apparatus. The keeper, among others, suggested altering the lighting plan.[18] The lantern continued to require repairs from time to time,

18. Samuel Tredwell to Albert Gallatin, Edenton, October 20, 1804, September 16, 1806, and December 23, 1809, Letters from Lighthouse

indicating that a permanent solution was not instituted at this time.

Until 1815, the War of 1812 militated against deep concern for the condition of lighthouses. But there was another more practical reason for not undertaking definite repairs at this time: the Federal Government had entered into a contract with Winslow Lewis of Boston, Massachusetts, to overhaul the lighting apparatuses of this country's lighthouses. Lewis had patented an apparatus that consisted of an argand lamp, parabolic reflector, and a lens. The argand lamp, devised by the Swiss inventor Ami Argand in 1782, had a hollow circular wick which permitted the air to flow not only outside the wick but also up through the center, thus allowing a more intense and even flame. The parabolic reflector was patterned on a mold Lewis made. According to one latter-day pharologist, the reflector approached the paraboloid about as closely as did a barber's basin. The lens was a molded, pale green glass that actually diminished the light rather than magnified it as Lewis intended. In time Lewis recognized this fact and removed the lens from all the lighthouse lamps.

Superintendents, Box 10; Lighthouse Letters, October 1, 1802-September 27, 1809, pp. 222, 248, 347; Lighthouse Letters, October 6, 1809-May 24, 1817, pp. 15, 488; Samuel Tredwe11 to Albert Gallatin, Edenton, August 9, 1810, Early Lighthouse Correspondence, Misc., 1800-1814.

Lewis placed a number of these lamps and reflectors on a chandelier in each lantern. If the light was intended to be fixed, the chandelier remained stationary, but if the light was to be flashing, a clockwork system, propelled by a falling weight, rotated the chandelier. The number of lamps placed in each lighthouse lantern varied. The Cape Hatteras lantern, for example, had 18 lamps and reflectors. Despite the faults of these lights, they were a definite improvement over the old system. Not only did they give a better light, but their use resulted in a tremendous saving in oil.

Despite the improvement in the lighting system of Cape Hatteras, complaints about the light began to be voiced, and the voices became particularly vehement in the late spring of 1817. The complaints, however, had overtones of something other than altruistic motives about the welfare of seamen. In April 1817 John D. Delacy of Beaufort wrote the Secretary of the Treasury, William Crawford, reminding the Secretary he had written him three months previously and still the "complaints against the keeper of the Light House at Hatteras is [sic] loud and deep." More specifically, Delacy contended,

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19. Richard W. Updike, "Winslow Lewis and the Lighthouses," *The American Neptune.,* v. XXVIII, No. 1 (Jan. 1968), pp. 34-37; A. B. Johnson, *The Modern Lighthouse Service* (Washington: 1890), p. 29; Samuel Tredwel1 to Samuel smith, Edenton, July 29, 1815, Letters from Lighthouse Superintendents, Box 10..3

> The Light House at Hatteras particularly is very often without any light in the most tempestuous, and dangerous weather, and ...it is frequently lighted and kept bright and clear for two and three Hours in the beginning of the night and then permitted to go out entirely which makes it "much worse and more dangerous than if there was no light at all shewn [sic] particularly as it is alledged [sic] by some that lights are some time seen to the southward or northward of it, most probably accidentally made by fisherman or some others, which fires it is urged conduced to lead vessels astray from the light in the light House being permitted to be extinguished, while the keeper of it Mr. Farrow or Pharoah being said to be commissioner of wrecks under state laws gives room for suspicions and reflections" on him probably unfounded.

After sinking the harpoon into the hide of Farrow, Delacy then turned humanitarian and attempted to remove it in such fashion as to leave the most hideous wound. He confessed that he had favorable reports of Farrow from his friends and surely Farrow would "not intentionally be guilty of so dreadfully criminal an act...still the great number of vessels cast on shore and of course property lost in the course of last fall and winter and this spring call loudly and imperiously for some immediate radical change for the prejudices and doubts existing against him as the keeper of that light House that there is something wrong somewhere...." Delacy then urged that the lighthouses be taken away from the management of the Collectors, and put directly under the Secretary of the Treasury. Collectors, he contended, were "too frequently influenced by motives of kindred or some other inducement in making the appointment

[of keeper]." The Department should never appoint a keeper

> from the immediate district or neighbourhood [sic] [because his neighbors] are his relatives and friends and where all are wreckers and that melancholy occasions occur of their indulging their proverbial crudity, The keeper of the neighbouring light particularly if there happens to be no light [in the lighthouse] at the time of the accident will become at least an object of suspicion.[20]

In response to these charges, the keeper of the Cape Hatteras light, Joseph Farrow, admitted, in effect, that the light had been bad but he stated that the oil that had been shipped to him was of inferior quality and would burn but a few hours. Interestingly enough, the keeper of the Shell Castle light, who was also under fire for keeping a poor light, complained also of the oil. Winslow Lewis, who supplied oil at this time for the country's lighthouses, dispatched his agent to the Outer Banks to test the oil. The agent found the oil to be indeed of poor quality, and left a barrel of good oil with the promise to ship more as soon as possible.[21] The oil was slow in arriving, but it did finally get there and the problem was solved; at least the records indicate so, since the complaints ceased.

One would like to think that Delacy had the purest of motives for writing so sharply of the Cape Hatteras keeper, but whatever

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20. John D. Delacy to William Crawford, Beaufort, North Carolina, April 29, 1817, Letters from Lighthouse Superintendents, Box 10.

21. *Ibid.;* Samuel Tredwell to Samuel H. Smith, Edenton, June 5, 1817, Letters from Lighthouse Keepers, Box 10; Lighthouse Letters, October 6, 1809-May 24, 1817, p. 593.

his motives may have been, they certainly should be viewed with suspicion since he transmitted a letter from William Bell, a retired ship's master who was a fellow townsman of Delacy's. Bell was applying for the job of keeper of the Cape Hatteras light.[22]

Two years later, in late 1819, two ship captains complained to the Commissioner of Revenue of the poor light at Cape Hatteras. The Commissioner instructed Tredwell to investigate, suggesting that possibly the keeper had not been wiping the tube glass two or three times a night as he was supposed to. When Tredwell informed the keeper, Joseph Farrow, of the complaint, the keeper replied that the poor light was not due to dirty lamp chimneys, but rather to the reflectors not being cleaned properly; Farrow said he did not have on hand the liquid used in cleaning the reflectors. Actually the keeper was a little taken aback when Tredwell suggested that the lamp chimneys should be wiped several times during the evening. He said Winslow Lewis had not instructed him to do that, and anyway the tubes were too hot to wipe.

This action on the part of the Collector, Tredwell, failed to produce a better light at Cape Hatteras, for the complaints continued

22. William Bell to William H. Crawford, Beaufort, North Carolina, April 29, 1817, and Delacy to Crawford, April 29, 1817.

to come to the attention of officials in Washington. Perhaps a more drastic step would have been taken sooner to improve the light at Cape Hatteras, but about this time the general supervision of the country's lighthouses were shifted from the Commissioner of Revenue to the office of the Fifth Auditor of the Treasury. The Fifth Auditor, Stephen Pleasonton took over his additional duties in 1820, and apparently immediately began receiving complaints about the Cape Hatteras light. Finally, in the spring of 1821 the culmination of dissatisfaction with the light was reached when a number of ship masters and merchants published a complaint about Cape Hatteras in a North Carolina newspaper. This public notice was more than Pleasonton could take, and he ordered the Collector “to remove the present keeper, and to appoint a person whom it is hoped will with more fidelity execute the important duties required of him.” To replace Joseph Farrow, the Collector nominated Pharoah Farrow. In April 1821 the formalities were completed when the President appointed Farrow to the position. In notifying the local Collector of Customs of the appointment, Pleasanton appended a statement that was to become standard in his letters of this type for the next 30 years. He said: “You will be pleased to notify him [Farrow] of his appointment and of the necessity of his residing and being himself steadily in the house provided for the keeper.”

At about the same time Pleasanton decided to take another measure to see that a good light was maintained. He shifted the responsibility of the light from the Edenton collector to the collector at Washington, North Carolina, "Upon the supposition that the trade from thence passing and repassing by the Cape more frequently, the Superintendent will have it in his power to ascertain, from time to time, the manner in which the light is attended to by the keeper, and to correct any abuses which may be found to exist." Pleasonton added that this decision did not reflect dissatisfaction with Tredwell; it was just that he felt Tredwell was too far away to oversee the light properly.[23]

REPAIRS

The Cape Hatteras lighthouse was now getting to an age where certain repairs were needed to it and the dwelling. Most of the repairs, however, were of a routine nature, such as repainting and reshingling the dwelling. But there were two of interest: sand was once again blowing away from the foundation of the tower, and the tower was in need of whitewashing. Tredwell resurrected the suggestion of placing tar around the foundation to prevent the sand

23. Samuel Tredwell to S. Pleasonton, Edenton, July 15, 1820, Letters from Lighthouse Superintendents, Box 10 Lighthouse Letters, May 27, 1817-Decernber 20, 1821, pp. 217, 365, 366, 379, 383, R. G. 26.

from blowing away, but he recommended against whitewashing the tower, reasoning brilliantly that it would have to be repeated in time. Pleasonton and his predecessor, the Commissioner of Revenue, at separate times authorized Tredwell to make the routine and major repairs; however, they did not specifically state just what was to be done about the erosion problem other than fill the sand back in around the foundation of the tower. When the problem arose several years later Pleasanton simply instructed Tredwell "to take measures to prevent the decrease of the sand endangering the safety of the Light House...." The Commissioner of Revenue did, however, permit Tredwell to omit whitewashing the tower. Thus both Tredwell and the commissioner missed the point of whitewashing the tower.[24] Had they had some experience at sea or greater knowledge of navigation they would have realized that such work was not done solely to preserve the structure, but also to make the tower stand out and thus be a better day mark to the mariner.

THE FIRST CAPE HATTERAS LIGHTSHIP

The desire to place a light on the shoals off Cape Hatteras is one of long standing. As early as 1806 Congress authorized a survey

24. Samuel Tredwe11 to Samuel H. smith, Edenton, June 5, 1817, and August 8, 1818, Letters from Lighthouse Superintendents, Box 10; Lighthouse Letters, October 6, 1809-May 24, 1817, p. 593; Lighthouse Letters, May 27, 1817-December 20, 1821, p. 383. During the early

of the coast of North Carolina, the principal objective of which was to find a way to mark the shoals of Cape Hatteras, Cape Lookout, and the Frying Pan. Of these shoals Congress said:

> With the exception of Nantucket shoals, it is supposed there is no part of the American coast where vessels are more exposed to shipwreck, than they are in passing along the shores of North Carolina, in the neighborhood of these shoals. The Gulf Stream certainly approaches very near the American coast in this quarter; indeed, experienced navigators assert, that it touches Cape Hatteras shoals in its progress to the northeast, out of the Mexican gulf, and, as it runs with great rapidity hereabouts, they can place very little dependence on the ship's reckoning. Their estimated distance from land, therefore, is often found to be very erroneous, and as no soundings are to be procured within a short distance from the outer part of the shoals, it too frequently happens that shipwrecks take place; and hardly a season passes that does not afford the melancholy spectacle of stranded ships, and a great destruction of property is sure to follow: and it is fortunate, indeed, if the friendless mariner escapes with his life.

The survey specifically was to determine the feasibility of erecting a lighthouse on the tip of Cape Hatteras Shoals, "which have been long a terror to navigators." By the following January the survey party had done its work and reported that it would not be advisable to erect the lighthouse on the shoals since the bottom consisted "of loose and shifting sand" and since no lighthouse could withstand

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years of the Cape Hatteras lighthouse the district superintendent of lights had to clear all repairs with Washington, delaying considerably the undertaking of such work, much of which was routine. In 1822 Pleasonton, in an efficiency move, instructed the district superintendent to authorize repairs that did not exceed $100. See *Ibid.,* p. 500.

for long the constant buffeting of the ocean that would happen at these shoals.[25]

In 1819 the Senate of the United States requested a survey of the coast of North Carolina. President Monroe instructed the Navy Department to undertake it. The survey party, apparently headed by Captain Jesse D. Elliott, USN, reported in 1821, recommending that lightships be placed off Cape Hatteras, Cape Lookout, and Cape Fear.[26] The problem the navigator faced on this coast was succinctly spelled out by the commission:

> Cape Hatteras being the angular point which all our vessels endeavor to make as a headland…calls, with great force, for some better means of designating it than by a Light-house so far distant from a point of danger and approach; the result of which is clearly demonstrated by the loss of the ship Horatio, of New York, during the last winter. The number of vessels that become embayed and stranded, after having made…land to the eastward or westward, is incredible. To the south they have encountered the danger before they…have received any intimation of its existence; and, in other instances, when the weather is at all inclined to be …thick, the great anxiety of the masters of coasting vessels is to avoid the shoal, when, imperceptibly, they are…into the [Gulf] stream, where they encounter weather more boisterous, and, if destined for the south, have a current…at least three miles an hour to contend with.

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25. *American State Papers, Class IV, Commerce and Navigation,* v. VII (Washington: Gales & Seaton, 1832), (Serial #014), pp. 639, 690-691.

26. *American State Papers, Class IV, Commerce and Navigation,* v. II (Washington: Gales & Seaton, 1834), (Serial #15), pp. 520-521.

At about this same time the North Carolina Board of Internal Improvement recommended that buoys be placed to mark the channels through the shoals at Cape Hatteras, Cape Lookout, and Cape Fear. On receiving this request, P1easonton passed it on to Congress with a request for $1,600 to do the work. Congress appropriated the money, and P1eansonton instructed Thomas Blount, the Collector at Washington, North Carolina, to purchase the requisite buoys. Blount later wrote that the appropriation was inadequate, to which Pleasonton replied that Blount should bUy as many buoys as the money allowed and place those buoys at the most important spots.[27]

Soon Congress appropriated money for two lightships, one for Cape Hatteras. Pleasonton quickly went about having specifications for the lightships drawn up, and in May 1823 successfully negotiated with Henry Ekford of New York to build the two vessels. Construction went well, and the following November Captain Jesse Elliott, who had pushed especially hard for the lightship and had been instrumental in getting Congress to pass the law establishing the lightship at Cape Hatteras, volunteered to journey north to inspect the completed vessel. Pleasonton was appreciative of Elliott's offer and made arrangements to pay his expenses to New York.

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27. Lighthouse Letters, May 27, 1817-December 20, p. 389; Lighthouse Letters, May 20, 1822-February 28, 1826, pp. 8, 52.

In April 1824 Pleasonton notified Captain Christian Erickson of Philadelphia that he had been appointed master of the Cape Hatteras lightship; his salary was to be $800 per year. Erickson was ordered to the ship on April 10, 1824. In addition to the captain, the ship's crew was to consist of a mate and four or five seamen. In June 1824 the Captain's salary was lowered to $700 per year and the mate's established at $350 per year; Congress had set both salaries. Previously Pleasonton had authorized a ration allowance of 25 cents per man per day.[28]

In June 1824 the Cape Hatteras lightship was ready for sea. Captain Elliott volunteered to go out with the ship and place it on station. Pleasonton gratefully accepted Elliott's offer, agreeing to pay his expenses. Supplied adequately with oil, wood, and water, the ship left New York around the middle of June, with Captain Elliott aboard, and arrived on station sometime before the end of the month,

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28. Lighthouse Letters, May 20, l822-February 28, 1826, pp. 121, 144, 244-246, 266, 275. Captain Jesse Elliott was a controversial naval officer somewhat addicted to dueling. Born in Hagerstown, Maryland, he was second in command to Commodore O. H. Perry at the Battle of Lake Erie and played a questionable role there. The Navy Department promoted him to Captain in 1818, and at that time selected him to be a member of a commission to choose permanent sites for navy-yards and fortifications. It was during this tour of duty that he pushed for the establishment of the Cape Hatteras light vessel. He later commanded the West Indian Squadron, and still later the Mediterranean Squadron, which led to further controversy and eventually to suspension from duty for four years. His last command was the Philadelphia Naval Yard, where he died in 1845. See *Dictionary of American Biography* (New York: 1943), v. VI, pp. 96-97.

for at that time the vessel was placed under the superintendence of the Collector at Norfolk. Elliott was highly displeased with Captain Erickson's "intemperate conduct," the details of which have been lost. On his return to the mainland Elliott wrote Pleasonton of his views. Pleasonton was sufficiently impressed and recommended the removal of Erickson and the appointment of Captain Lief Holden in his place. On July 31, 1824, Pleasonton announced that the President had appointed Holden master of the Cape Hatteras Lightship.[29]

The most important feature of the light vessel—the light—had been designed by Commodore James Barron. Barron, another controversial Naval officer, had surrendered the Chesapeake to the British Leopard in 1807, and in 1820 had killed Stephen Decatur in a duel. As a result of the death of the popular Decatur, Barron was never given another assignment. With little but time on his hands, Barron apparently turned to devising a lightship lighting apparatus. The acceptance of his contrivance by the lighthouse establishment may have been aided materially by his acquaintanceship with Captain Elliott, who had served under him on the Chesapeake. Apparently the unique feature of Barron's lighting apparatus was

29. Lighthouse Letters, May 20, 1822-February 28, 1826, pp. 249251, 277, 282, 295, 296.

the lamp, but just what was the design of this lamp is not known. At any rate Pleasanton paid Barron $550 for lamps for three lightships—the one at Cape Hatteras and two assigned to Delaware
Bay.[30]

The vessel at Cape Hatteras displaced over 300 tons and had two lights—one 60 feet high and the other 45 feet. Elliott had positioned the ship 13 miles east-southeast of the Cape Hatteras lighthouse. Seven miles of clear water separated it and the northflowing Gulf Stream. The ship remained here until February 1825 when a severe gale parted the vessel's moorings and drove it a considerable distance to sea. The ship finally made its way to Norfolk, arriving on February 12, 1825, in need of considerable repair. An examination revealed that repairs would total $12,000. Work began on the vessel, but it proceeded at a snail's pace, and on December 10 Pleasonton wrote there had been difficulty in getting the ship repaired and refitted. There had been special problems getting an anchor and cables. Pleasanton, however, hoped to have the work on the vessel completed by December I5. While this work was going on, a 6-pound cannon was authorized for the lightship.[31]

30. Lighthouse Letters, May 20, 1822-February 28, 1826, pp. 155, 288, 383; *D.A.B.,* v. I, pp. 649-650.

31. Blunt, *American Coast Pilot,1827,* p. 124; Lighthouse Letters, May 20, 1822-February 28, 1826, pp. 371, 372, 431, 462, 480.

The reason for this gun is not known, but presumably it was to be used as a fog signaling device.

The following May the light vessel parted her moorings again, and Captain Holden headed her for port. The loss of the anchor and cable disturbed Pleasonton, who was one of this country's most assiduous guardians of the public dollar. In Pleasonton's book of values saving a few dollars was far more important than providing for the safety of seamen. He ordered ships out to search for the anchor and cable while the lightship remained in port. When this expedition, under the guidance of Captain Holden, returned empty handed, Pleasonton decided to stimulate private enterprise by offering a reward of $500 for locating the anchor. At the same time he instructed Holden to keep the vessel in Port another month or until the anchor was found. Finally toward the end of June when the anchor still had not been recovered Pleasonton began to reconsider and instructed the Norfolk Collector to obtain anchor and cable of the type Commodore Barron recommended, “it being of more importance that the vessel should be at her station than would be the saving of a few hundred dollars, if that event be delayed.” Arrangements were made with a Baltimore manufacturer to make the anchor and cable, and in October Pleasonton received permission

from the Navy to use their Washington facilities to test the new cable.[32]

It is not known when the vessel was returned to station, but one would surmise around the first of November; the lightship had been off station about five months, and all for want of an anchor and cable. One has to look at the absence of the light vessel from the sailor's point of view. The average seaman was expecting to see the ship on the Cape Hatteras Shoals; indeed, the Coast Pilot and other navigational aids said there was one there. One wonders how many ships went aground looking for the lightship that wasn't there.

The Cape Hatteras Lightship broke her moorings for the last time in August 1827. A gale drove her off station and onto the shore six miles south of Ocracoke Inlet, in the vicinity of Whalebone Inlet on the Core Banks. Pleasonton attempted to enter into a contract with a company to remove the vessel from the beach, but the contractor could not meet the Government's specifications. Finally, after exhausting all efforts to refloat the ship, Pleasonton on May 25, 1828, instructed the Collector at Ocracoke to hire someone to break up the lightship and salvage everything possible. Particularly, Pleasonton wanted saved the “Lantern, bell, cables, if there

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32. Lighthouse Letters, March 1, 1826-Apri1 14, 1829, pp. 24, 29, 35, 50, 69, 91.

be any, and any such other articles as may be usefully employed in other floating lights….[33] Presumably the Collector took the requisite action.

MEANWHILE BACK AT THE LIGHT STATION

In the late 1820s and early 1830s things began to deteriorate at the Cape Hatteras Light Station. By 1827 the keeper's dwelling was in such bad condition that Pleasonton authorized the Collector to erect a new structure, if it could be done for less than $1,500. Moreover , if not enough land was available on which to erect the house, the Collector, Blount, was authorized to purchase a sufficient piece of adjoining land "at a reasonable price." There apparently was not enough land, and on July 21, 1828, Pharoah Farrow sold to the government a tract of land "containing forty acres more or less...for and in consideration of the Sum of two hundred Dollars...." The tract was adjacent to and just north of the original plot on which the tower rested. The new keeper's house was erected on this plot of land.[34]

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33. Lighthouse Letters, March 1, 1826-April 14, 1829, pp. 219-220, 230, 232, 234-235, 304-305, 313, 418.

34. Lighthouse Letters, March 1, 1826-April 28, 1829, p. 221; Site File, Cape Hatteras Light Station.

In October 1829 a complaint reached the newspapers about the poor quality of the Cape Hatteras light. But that problem seems to have been solved by an admonition through the local collector. The keeper at this time was Pharoah Farrow. His residence, however was not near the lighthouse, and apparently not wishing to live on the light station, he hired several [African Americans] to tend the light. Pleasanton heard about Farrow's arrangement in 1830 and promptly removed him as keeper. Isaac Farrow was appointed keeper of the light in his place.

By 1834 it became apparent that the Cape Hatteras Light Station was in sore need of repair and maintenance. In June 1835 an inspector appointed by Pleasanton reported that the Cape Hatteras Lighthouse was in very bad condition. The lantern was too small, "and...so much rusted and injured as to require the substitution of a new one." The window sills in the tower were in an advanced state of decay, and, moreover, the foundation of the dwelling needed enclosing, for otherwise the wind would carry away all the sand and thus endanger that structure. Pleasonton ordered all repairs made and authorized the Collector to have a new lantern constructed. Winslow Lewis proposed supplying the lantern and all its fixtures, including new

lamps, for $3,000 and the old materials. Pleasonton instructed the Collector to accept the offer.[35]

In the meantime the Cape Hatteras light had acquired a reputation for unreliability. The captain of a steam packet engaged in the coasting trade reported in a Philadelphia newspaper that he had recently passed the Cape Hatteras light, and "there was, as usual, no light to be seen from the lighthouse." On hearing of this complaint Pleasonton ordered the Collector to investigate, and if the indicated neglect was habitual, fire the keeper.[36] Undoubtedly, there had been a light in the tower. Probably the apparatus was in such poor condition and the light so dim that it would not carry out to the shipping lanes.

Apparently Lewis went about refitting the Cape Hatteras tower in the fall of 1835, for on the day after Christmas of that year Pleasonton inquired of Lewis if he had finished the work yet. Just when Lewis completed the task is not known, but by April of 1836 Pleasonton had received Lewis' bill for $3,061, and Pleasonton, completely in character, was deeply disturbed by the additional $61, although Lewis was able to explain it to Pleasonton's satisfaction. The contract called for 18 lamps to be installed. In the

35. Lighthouse Letters, April 14, 1829-Ju1y 12, 1831, pp. 118, 358; Lighthouse Letters, May 7, 1833-June 9, 1835, pp. 214, 302, 439; Lighthouse Letters, June 10, 1835-February 15, 1837, pp. 15, 89: Lighthouse Letters, July 13, 1842-August 26, 1843, p. 209.

36. Lighthouse Letters, June 10, 1835-February 15, 1837, p. 112.

annual report of the Collector, Blount said that only 16 lamps were lighted. Pleasonton was upset over this report also, not because the brilliance of the light may be diminished by the absence of the two lamps, but because the number of lamps determined the amount of oil purchased from the contractor.[37]

The refurbishing of the Cape Hatteras light had the proper effect on the quality of the light that emanated from the tower. And in 1838 the Collector reported favorably upon the station and that the keeper was faithfully and adequately performing his duties. An inspection of all the country's lighthouses in 1838 ordered by Congress reported that the Cape Hatteras lighthouse was fitted with 18 lamps and the light was in excellent order.[38]

THE LIGHTHOUSE, 1838-1861

Just five years after the tower had been fitted with a new lighting apparatus, the Collector wrote Pleasanton that the lamps and reflectors were almost useless. Pleasonton, understandably enough, was furious, and immediately accused the keeper of carelessness, of ignorance of his job, and of having injured the

37. Lighthouse Letters, June 10, 1835-February 15, 1837, pp. 166, 237, 387.

38. Lighthouse Letters, January 1, 1838-0ctober 17, 1838, pp. 412-413; 25th Congress, 3rd Sess., Ho. Doc. No. 24 (Serial #345), pp. 104, Ill.

lamps. He felt that Winslow Lewis, who had installed the apparatus, could not have done a poor job since he "always has done good and substantial work." Properly taken care of, lamps and reflectors, Pleasonton said, should last 20 to 25 years. Pleasanton ordered the Collector to investigate and find out if the keeper had indeed been derelict in his duties. If so, Pleasonton intended to remove the keeper. He also instructed the Collector to have the lamps repaired temporarily until some new ones could be sent by Winslow Lewis. The Collector replied that he was sure the lamps could be repaired, and he was at that time sending a workman down to undertake the work.[39] Whether it was necessary ultimately to send new lamps to the Cape Hatteras station or whether the keeper was guilty of carelessness is not known. In view of the fact the keeper was not removed and of what subsequently happened to the lighting apparatus, one can state with reasonable certainty that all the lamps required and received repair work.

In 1842, two years after this brouhaha the keeper, Isaac S. Farrow, died. The Collector recommended as his replacement the former keeper Pharoah Farrow. Pleasonton recalled the circumstances of Pharoah's removal in 1830 and promptly rejected the recommendation,

39. Lighthouse Letters, v. 15, pp. 228-229, 250-251.

saying, "We cannot be too careful in making a selection for this lighthouse, as it is so remote from inhabitants, and so important that the light should be faithfully attended to." Joseph C. Jennett was appointed a week later to the position of keeper of the Cape Hatteras light. Interestingly enough the original of the appointment was given to Congressman Edward Stanly for delivery to Jennett. Perhaps Pleasonton was playing politics since the usual procedure was for such appointments to be sent to the Collector for delivery to the appointee.

In July 1845 Pleasonton received word that the Cape Hatteras lighthouse and lighting apparatus was in "excellent condition." Two years later Pleasonton received word from the Collector and the captain of the lighthouse supply vessel that the Cape Hatteras lighting apparatus "requires renewing." Pleasonton was disturbed at this latter news since the apparatus was only 10 years old, but he was not upset as he had been over the same news five years previously. The needed repairs at first were not as extensive as those first envisioned in 1840. Actually about all that was needed was the replacement of eight reflectors and the glazing of the lantern door. This door was made of sheet copper and it had been

40. Lighthouse Letters, July 13, 1842-August 26, 1843, pp. 208-209, 212, 213. Jennett remained keeper until 1845 when he was removed and Benjamin Fulcher was appointed keeper. See Lighthouse Letters, June 9, 1845-Apri1 27, 1846, pp. 18-19.

so placed as to obscure part of the light of the lamps. Pleasonton felt replacing the copper with a glass door would solve the problem.[41]

Pleasonton's first inclination was to postpone the work for a year, but the supply vessel captain persuaded him otherwise when he said "that this is the most important Light on the whole coast & requires immediate attention."

Pleasonton wrote Winslow Lewis asking what he would charge to replace the reflectors with the larger 21-inch size and glaze the lantern door. In reply Lewis offered to put up a new stone deck on the Cape Hatteras tower, place a new lantern, and fit up the lantern with fifteen 21-inch reflectors for $4,175 and the old materials. Pleasanton felt this was too much since Lewis had fixed the Cape Henry light in the same way for $3,500. He was willing to concede that the landing of materials at Cape Hatteras would be more difficult, but $500 should be an adequate additional charge for this work. Lewis responded that he would be willing to do the work for $4,000 and the old materials or $4,075 and leave the old materials. Pleasanton took the first alternative.[42]

Just who persuaded Pleasanton to go to the more extensive task of replacing lantern and lighting apparatus is not known. His reason

42. Lighthouse Letters, June 9, 1845-Apri1 27, 1846, pp. 67-68, 70, 163.

for doing it, at least as given to the local Collector, was that the old lantern was "much too small for such a tower." Perhaps Lewis, whom Pleasanton tended to trust and respect greatly, convinced Pleasanton that using the larger reflectors required a larger lantern. But whatever the case, Lewis went about his work installing the new lantern, and fitting it with lamps and reflectors. He erected a temporary light for use while this work was being done. By December he had finished and departed Cape Hatteras, leaving behind 13 extra panes of plate glass for the lantern. Lewis's total bill was $4,091, the extra $91 being for the glass. Pleasonton authorized payment.[43]

The Collector reported to Pleasanton that the new light was a great improvement, and Pleasonton said he had been told that the light could be seen 30 miles at sea.[44]

The lantern was barely two months old when the first storm struck, breaking several panes of plate glass and smashing almost all the lamp chimneys. On September 7 and 8, 1846, another storm pounded the light tower, this time breaking a large number of panes in the lantern and damaging the lightning rod. When Pleasanton

43. Lighthouse Letters, June 9, 184S-Apri1 27, 1846, pp. 173, 287.

44. Lighthouse Letters, June 9, 184S-Apri1 27, 1846, p. 390; Lighthouse Letters, April 27, 1846-December 14, 1846, p. 390.

learned there were not enough spare panes to reglaze the lantern, he became a little excited and surmised that the keeper "must be a very careless man or has disposed of them...." Pleasanton ordered from Lewis new panes for the Cape Hatteras lantern with instructions not to send Boston glass, "which is not so strong or clear." At the same time he instructed the Collector to "inquire and inform me how it has happened that the keeper has used so many lantern and tube glasses in so short a time."[45] Pleasonton could get excited quicker over the expenditure of a few extra dollars than he could over the quality of light available to guide the mariner.

Although the problem of sand blowing away from the foundation of the tower was one of long standing, it seems that little was done toward a permanent solution to the problem until 1850. In 1847 the problem arose again and Pleasanton considered it a very serious one. His solution was "to make a board fence about 3 feet above the ground and carried around the Light House about 4 feet from the wall and the intermediate space to be fitted in with brush." The brush, he felt, would keep the sand from blowing over the fence. In spite of the fact that a contract was let for some fairly extensive

45. Lighthouse Letters, June 9, 1845-April 27, 1846, p. 390; Lighthouse Letters, April 27, 1846-December 14, 1846, pp. 305-307.

repair work on the tower in 1848, nothing was apparently done about the fence, for in 1850, in passing on his wishes to the Collector, Pleasanton wrote: "The fencing around the tower and brushing, appearing to be as necessary as any other part, you will have the whole made in the best manner, within your estimate." Shortly thereafter the Collector received bids to make the fence for $240. The work was obviously done at this time for the following year the Collector requested $35 to repair "the puncheon fence around the upper terrace of Light House and [refill] the same with brush wood."[46]

CAPE HATTERAS AND THE LIGHTHOUSE BOARD

The 1850's was a significant decade in the history of the United States' aids to navigation. Under the conservative administration of the Fifth Auditor of the Treasury there had been little or no technological advancement. When he took over the administration of lighthouses the technique of lighting was the lamp and reflector system, and he did not change it, despite the fact that many of the other nations of the world had gone to the Fresnel lens. This lens

46. Lighthouse Letters, March 2, 1847-Ju1y 24, 1847, p. 380; Lighthouse Letters, December 22, 1848-May 12, 1849, p. 122; Lighthouse Letters, January 25, 1850, February 18, 1851, pp. 412-413, 516; Lighthouse Letters, February 18, 1851-February 28, 1852, p. 439. During this period Benjamine Fulcher resigned as keeper and in May 1849 Joseph C. Jennett was appointed in his place. Hezekiah F. Barnett had an interim appointment until Jennett took over. See Lighthouse Letters, May 14, 1849-January 25, 1850, p. 24.

gave a better light and was simpler to operate. Not only were personnel most often political appointees, but they also received little training in the operation of lighthouses, and the result in many cases was an indifferent attitude on the part of the light keepers to their task. New lighthouses were often located without full consideration of their effectiveness to the mariner and without regard to their relationship to each other. These things were not intentional on the part of Pleasonton, but rather reflected a general lack of understanding, or feeling for, aids to navigation and their purpose. The result of all this was a steady pressure building up to have something done about improving American lighthouses. Ship captains protested about the quality of aids to navigation, and on occasion chambers of commerce voiced disapproval of the country's lighthouses. The chief critics were E. &G. W. Blunt, publishers of the Coast Pilot, the forerunner of the Light List and the American Coast Pilot. Ship captains would write them complaining of the lights, and they forwarded the complaints on Washington.

The pressure gradually increased over the years, and the Fifth Auditor did little to relieve it. The explosion came in 1851 when Congress appointed a Board composed of Army and Navy Officers and scientists who were "to inquire into the condition of the Lighthouse Establishment of the United States…." Their report, consisting

of over 750 printed pages, was a detailed examination of the administration and technology of this country's aids to navigation, and was highly critical of both. The report resulted in Congress creating a Lighthouse Board, directly under the Secretary of the Treasury, to manage the United States' aids to navigation. The Board, composed mostly of those who were members of the original investigating Board, took over its new duties in the autumn of 1852.

As this activity on the national scene transpired, the Cape Hatteras light was coming in for more criticism. In late 1850 G. W. Blunt issued a notice to mariners in which he said that on request a friend investigated the Cape Hatteras light and found that "The light is notoriously a bad one, and so far as can be judged from external appearances, it is badly kept." The tower had not been whitewashed or painted ever. The lantern, the notice went on, had two tiers of reflectors; a third tier had long since been removed. The lower tier of lamps was too low and poorly arranged on the frame to enhance the quality of the light. Not only were the lamps and burners in poor condition, but the burners were improperly adjusted. In general the lantern exhibited "a great want of cleanliness everywhere." In consequence of his findings the investigator felt that the light was not visible at sea as far as the height of the tower would allow. A slave reportedly tended the light, the keeper

being absent at one period for three months. On at least one night in October the light was out for three hours. In general the Cape Hatteras light was inferior to the ones at Bodie Island and Ocracoke. “There is no point on our coast,” Blunt said, “with which I am acquainted that requires a better light than Cape Hatteras.”

The local Collector, R. H. J. Blount, came quickly to the defense of the keeper. He said he had talked to a number of masters of vessels, and they felt the charges against the keeper, Joseph C. Jennett, were not true. Blount was aware that the keeper had a Negro slave who “performs most of the labor of cleaning [,] lighting [,] &c--but under the constant personal inspection of the keeper.” To buttress his defence of the keeper Blount supplied a number of affidavits from pilots in the Cape Hatteras area who said that Jennett was a good keeper and a number of statements from friends and neighbors who said that Jennett was always at the station and that there was a good light burning all night in the lighthouse. Even a former keeper, B. F. Fulcher, stated that Jennett was doing a good job and kept a good light. Blount expressed bewilderment at the complaint of the tower having not been whitewashed. If whitewashing were really necessary, he did not understand “why it has been omitted for so many years.” The burners, he added, were bad because

the supply vessel left poor ones at the station. He said also that fog from a number of nearby ponds often obscured the light.[47] Of course the real point here is that the Collector had no real appreciation of the importance of the lighthouse to the seaman. In effect he admitted that Blount was correct about the condition of the lighthouse, but he offered excuses to get the keeper off the hook. If everything was as the Collector said, why hadn't he or the keeper complained before now? Why hadn't the bad burners been reported before? Why hadn't more vigorous action been taken to solve the problem of fog obscuring the light? Here again is further reason the Fifth Auditor's administration of aids to navigation was a failure: the local superintendents of lights seldom had any appreciation for the role of lighthouses and rather than initiate a little action to keep lighthouses in good condition, they tended to act only when stimulated by criticism.

Pleasonton felt that the reason for the obscuring of the light was the fact that the tower was too high. At least as early as 1846 he had expressed the opinion that the Cape Hatteras light was a little too high because the haze that prevailed on the southern coast often obscured lights that were around 100 feet above the ground. He said

47. R. H. J. Blount to Thomas Corwin, Washington, N. C., January 7, 1851, in Treasury Department, Lighthouse Letters, 1851-1852, Series P, pp. 2-7.

that it was best to be below the haze and that the most effective lights were those only 65 feet high. In 1851 he said the light was above the ground fog and therefore obscured, but when the fog was not present the light could be seen 25 to 30 miles. The question then was whether or not to lower the tower, although it would be a shame, Pleasonton felt, to do so to such a "fine" tower; the quality of a structure is certainly an important consideration when lives are involved. Before any action was taken, he suggested sending an engineer down to Cape Hatteras to study the problem and determine the causes.[48] Interestingly enough, the Collector also said that shipmasters had reported to him that they felt the tower was too high.

Pleasonton selected Benjamin Isherwood, chief engineer in the U. S. Navy, to study the problem of the Cape Hatteras lighthouse. He was particularly to pay attention to the effect of the fog on the light and decide whether the tower should be lowered. Isherwood visited the site in either late May or early June of 1851 and rendered a routine favorable report, drawing the conclusions that Pleasonton had predicted. He found at the station "nearly new" reflectors fitted on "clean and in fine order" lamps. From local

48. *Ibid;* Lighthouse Letters, April 27, 1846-December 14, 1846. p. 243; Lighthouse Letters, January 25, 1850-February 18, 1851, pp. 641643; Treasury Department, Lighthouse Letters, 1851-1852, Series P, p. 17.

pilots and shipmasters he found "that the keeper bears an excellent character and is moreover watchful and attentive to his duties." These same people also testified to the light's "full sufficiency for all purposes of navigation; and to its excellence as a first class Light…." The cause of obscuring the light, Isherwood contended, was a mist or low strata of fog that emanated from the warm Gulf Stream, and the condition was particularly severe when the wind was blowing from the east. This mist is prevalent, he said, along the east coast from New York southward and hovers at an elevation of about 100 feet. Lowering the tower would solve the problem, but then that would affect the distance the light could be seen and therefore would not be an adequate light to warn ships off Diamond Shoals. As a consequence Isherwood concluded "That modern science has hitherto utterly failed in producing any light capable of at all penetrating fog: the obscurations of Lighthouses due to this cause are therefore irremediable and must be endured as the inevitable result of natural laws beyond the power of man to abolish or modify."[49]

49. Lighthouse Letters, January 25, 1850-February 18, 1851, p. 649; Lighthouse Letters, February 18, 1851-February 28, 1852, pp. 221, 386. B. F. Isherwood to Stephen P1easonton, Washington, June 13, 1851, Lighthouse Letters. At this time Isherwood was a chief-engineer in the U. S. Navy, but within ten years he was to become Engineer-in-chief of the Navy and first chief of its Bureau of steam Navigation. His innovations in ship design and machinery make him one of the great engineers of the U. S. Navy. See *Dictionary of American Biography,* v. IX, pp. 515-516.

Pleasonton, evidently pleased with Isherwood's report, was inclined to follow the recommendation to let things remain as they were and do nothing. Shortly after Isherwood submitted his report Pleasonton wrote the local Collector not to "try and experiment, or make any alteration in the disposition of the lamps and reflectors, as you propose."[50] Nothing was done to improve the light and further action had to await the administration of the Lighthouse Board.

The Lighthouse Board was in the incipient stage as these events were transpiring, and had independently just inspected the Cape Hatteras Light Station. At this time the Cape Hatteras light tower from base to lantern was 90 feet tall. The lantern contained 15 argand lamps, each fitted with a 2l-inch reflector, and, according to the Lighthouse Board, all reflectors were "much worn." The lantern gave off a fixed light, visible in clear weather for 20 miles.[51]

The quality of the light left a lot to be desired. Lieutenant David D. Porter, U. S. Navy, wrote in 1851:

> ...I always had so little confidence in [the Cape Hatteras light] that I have been guided by the lead,

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50. Lighthouse Letters, March 1, 1852-0ctober 15, 1852, p. 234.

51. U. S. Lighthouse Board, *Compilation of Public Documents and Extracts from Reports and Papers Relating to Light-houses, Lightvessels, and Illuminating Apparatus, and to Beacons, Buoys, and Fog Signals, 1789 to 1871* (Washington: G.P.O., 1871), p. 882; *Report of the Light-House Board to the Secretary of the Treasury in Answer to a Resolution of the Senate of February 1, 1858, Calling Upon the Department for Information in Regard to the Expense of Erecting LightHouses, &c.* (Washington: 1858), pp. 44-45.

> 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 it is still a wretched light.

In addition, he advocated raising the light 15 feet.

Lieutenant H. J. Harstene, U. S. Navy, was blunter in his assessment of the Cape Hatteras light: "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, U. S. Navy, who was later to become a member of the Lighthouse Board, observed the lights along the North Carolina-Virginia coast including the one at Cape Hatteras during a tour of duty there as a hydrographer and commented on their "general inferiority." He attributed this fact to "the bad apparatus" employed in them, and to the want of knowledge and instruction on the part of those employed to keep and superintend them. This criticism could have been applied to virtually all the lights in the United States at that time.

Lieutenant H. K. Davenport, skipper of the mail steamer Cherokee, also had little regard for the light. He 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." The captain of the Venice gave identical testimony, and the master of the steamship Ludlow felt the Cape Hatteras light "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."[52]

After their minute and detailed study of the lighthouses and other aids to navigation of the United States, the Lighthouse Board concluded about the Cape Hatteras lighthouse:

> 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.

52. U.S. Lighthouse Board, *Compilation of Public Documents… Relating to Lighthouses…1789 to 1871,* pp. 738, 743, 753-754; *32nd Cong., 1st Sess., House Exec. Doc. No. 114 (Serial #648),* pp. 17, 23.

> 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 any unnecessary delay.[53]

Everyone recognized that the highly dangerous area in the vicinity of Cape Hatteras was not adequately lighted. The lighthouse with its outmoded and weak lighting apparatus was insufficient for the purpose it was intended to serve. Moreover, the tower's height put the lantern right in the middle of the haze that often dimmed the light and on occasion even obscured it. The Fifth Auditor's answer to the problem had been to maintain the status quo, since there was no cheap and completely satisfactory solution. On the other hand the Lighthouse Board felt the problem could be solved in great part and proceeded to do something. They placed a buoy off Cape Hatteras and one on the Diamond Shoals. Shortly after taking over this country's aids to navigation the board had asked the Engineer Corps to furnish an engineer to assist them with their technical problems in the field. One of this engineer's first tasks was to examine the Cape Hatteras light tower to see how high it could be raised and what needed to be done to install a First Order Fresnel lens

53. 32nd Cong., 1st Sess., House Exec. Doc. No. 55 (Serial #642), p. 138.

and lantern on it. The Engineer made his inspection, submitted his report, and in March 1853, on request from the Lighthouse Board, Congress appropriated $15,000 to elevate and refit the light tower. Work was apparently undertaken later in the year, for in March 1854 the Lighthouse Board reported that the work was to be completed at an early date.[54]

The work accomplished at this station was extensive. A brick addition raised the tower so that the focal plane of the light was 150 feet above sea level. The Board installed a revolving first order Fresnel lens in the lantern and built new quarters for the keepers. The refurbished tower exhibited a flashing light visible for 20 miles. The Board considered the tower also a day mark and painted it in such colors as to make it more distinguishable. They whitewashed 70 feet of the tower and painted the remainder red.[55]

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54. Lighthouse Board Journal, October 9, 1852-August 11, 1854, p. 422; Lighthouse Board, Letters to 5th District Inspector, 1852-1860, p. 56; Thornton A. Jenkins to J. G. Totten, Treasury Dept., November 16, 1852, Letters & Drawings, Construction, From Files of War Engineer, 1828-1876, Box 3; 33rd *Cong., 2nd Sess., Sen. Exec. Doc. No.2* (Serial #749), p. 304.

55. Report of the Light-House Board to the Secretary of the Treasury…In Regard to the Expense of Erecting Light-Houses, &c., pp. 98-99; Cape Hatteras Light Station, Clipping File.

For the next few years the Cape Hatteras Light Station had a fairly normal and quiet existence, indicating that at least some of the problems of the light had been resolved. Repairs were necessary from time to time, such as when the revolving mechanism of the lens went slightly wild and rotated the lens at a rate of 4 1/2 minutes instead of eight, and in 1855 when the newly constructed keepers' dwelling had to be painted with three coats because the builders had left it unpainted, and in 1858 when the problem of sand blowing away from the foundation of the tower arose again.[56] But these were fairly ordinary occurrences with each in time being resolved. The Cape Hatteras station had become a routine operation. With the exception of one, complaints about the quality of the light do not appear in the records. The one complaint appeared in January 1858 when A. S. Wadsworth of the U.S. Coast Survey reported that on at least three nights the Cape Hatteras light was out for several hours at a time. He said local pilots told him that such happenings were not unusual. At the same time the local superintendent of lights recalled that Captain Silas B1unt told him that when his ship the Arlitta wrecked on Cape Hatteras the light had been out.[57] There

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56. Lighthouse Board, Letters to 5th District Inspector, 1852-1860, pp. 160, 172, 314; *34th Cong., Zst* Bess., *Ben. Exec. Doc. No. 2* (Serial #814), p. 357.

57. Lighthouse Board, Letters to 5th District Inspector, 1852-1860, pp. 294-296.

is no evidence to indicate that the Lighthouse Board replaced the keeper at this time, although that would have been the normal practice if the keeper were guilty of negligence. The cause of the light's failure may have been a new and inexperienced assistant keeper, since one had just entered on duty a few weeks before Wadsworth's complaint.

CAPE HATTERAS BEACON

About the same time they modernized the Cape Hatteras lighthouse, the Lighthouse Board also turned its attention to providing an aid to coasting traffic bound for the sounds of North Carolina through the several inlets of the Outer Banks. These coasting vessels preferred cutting across Diamond Shoals through the Slue Channel. They required another, lower light in order to fix their positions and thus assure them of safe passage over these dangerous shoals. Congress in August 1854 appropriated $1,500 for a beacon near the point of Cape Hatteras. During fiscal year 1856, the Lighthouse Board erected the beacon near the southern extremity of the point and lighted it. The Board's selection of a site was not a good one, for they had not taken into account beach erosion, and in 1857 encroachment of the sea forced the Lighthouse Board to authorize moving the light to a safer location. The work was accomplished around the first of the year 1858.

The beacon was a framework structure surmounted by a lantern that contained a sixth order Fresnel lens. Both the structure and the lantern were painted red.[58]

In l858 the beacon was described as having a fixed light visible six miles. The focal plane of the light was 25 feet above sea level.

This light functioned until the arrival of the Confederates on the Outer Banks in 1861. When the Rebels put out the main ape Hatteras light, they eliminated the Beacon as a functioning light. They had damaged neither the structure nor the lantern; the Confederates had just removed the lens and its pedestal. The District Engineer did not feel that it would take more than a day to return the Beacon to operation. Indeed he put it into temporary operation with a steamer's lamp. When the Union forces regained effective control of the Cape Hatteras area the Lighthouse Board "restored and re-establishment" the Beacon at the same time they relighted the main tower.

For the next 17 years the Beacon continued to shine its light to guide coasting craft through these dangerous shoals. Then in 1879 the Lighthouse Board felt the light was no longer needed and had it

58. Clipping File, Cape Hatteras Beacon; Lighthouse Board, Letters to 5th District Inspector, 1852-1860, pp. 276, 283, 300; *Report of the Lighthouse Board to the Secretary of the Treasury in Answer to a Resolution of the Senate of February 1, l853…* (Washington: 1858), pp. 98-99; *34th Cong., 3rd Sess., House Exec. Doc. No.2* (Serial #896), pp. 600, 610.

discontinued. Howls of protest emitted from the salty throats of the coasters, and in time they made themselves heard. In 1882 the Lighthouse Board decided that coasting vessels still needed the Beacon "as a guide through the Slue Channel," and ordered its re-establishment. The old structure was repaired and refurbished and on December 15, 1883, the Beacon was re-exhibited.

Twenty-four months later a severe storm struck the area and "partially overturned" the beacon tower. This accident pointed up the poor physical condition of the old wooden frame structure, and the Board reached the conclusion that they would have to build a new one. The District Engineer had the lens "wedged up" and took other "temporary measures…to keep the light burning until a new structure could be built." Work began in the spring of 1886 and seven months later, on November 24, 1886, the new beacon went into operation.

Less than three years later the Beacon's old nemesis, shore erosion, threatened the new structure. On October 1, 1889, the high water mark was just 50 feet from the beacon, and during the month two severe gales gnawed away at the beach, permitting the Atlantic Ocean to lap but a few feet from the beacon tower. The Lighthouse Board had no choice but to move the light "farther back as soon as practicable." In January 1890,

> "Trestles were placed in position, iron braces were detached, the structure was lifted from the piles, moved to one side, lowered onto skids, and transported on rollers to its site, 200 feet distant. The foundation piles were then taken up and reset at the new

> location, the building was raised and placed upon the trestles and then lowered upon the piles. The necessary steps, gutters, etc., were replaced, and the structure, embracing house, iron-work, and lantern were painted.

Despite this work, the beacon was still not safe, and in the autumn of 1895 the keeper at Cape Hatteras reported the beacon "in danger of destruction by the waves." Within 24 hours the sea had eaten away the last 35 feet of beach, and "the high-water line had advanced as far as the piles of the structure." Action was taken to display a temporary light in event the beacon succumbed to the sea. Soon, however, the threat subsided and the beach began to rebuild.

As it turned out, the beacon had only a reprieve. Two years later, in 1897, a severe storm hit the Outer Banks, and whipped and lashed the ocean, driving the water onto the banks and completely submerging the Beacon. With this light inoperative, a lens lantern was placed on a post "in the vicinity but sufficiently remote from the shore line to be secure from destruction by the waves. This
substitute," the Lighthouse Board announced, "answers the purposes of Navigation as well as the former beacon."

But Cape Hatteras was still in an erosion cycle and in 1889 the "light post was moved 145 yards nearer to the tower, beyond the reach of the high tides." It would almost appear that nature had it in for the beacon light at Cape Hatteras, for in August 1899 a storm blew over the light-post. But the post was quickly re-erected and the light was re-disp1ayed on August 24, 1899. The 1900 Light

List shows the Beacon as being a fixed white light on a brown post 35 feet high. It was visible 10 1/4 miles. The Light List for 1907 does not show the Beacon.[59] The Annual Reports of the Lighthouse Board are no source of enlightenment on the fate of the Cape Hatteras Beacon.

HATTERAS INLET LIGHT

Recognizing the fact that the water over the bar at Hatteras Inlet had been gradually improving in depth for some years and that as a result the inlet was "becoming an important place of refuge as well as ingress and egress to the many coasting vessels passing that part of the coast," the Lighthouse Board in 1857 asked for an appropriation to erect a light at Hatteras Inlet. Congress, however, did not act for several years, but in 1860 it appropriated $5,000 to build the light. Almost immediately the Lighthouse Service began gathering the necessary materials to erect the lighthouse. The iron and woodwork was prepared at Wilmington, Delaware, and when finished all the material was collected and shipped to Hatteras Inlet along with a working party sufficient to erect the structure. On arriving at the inlet, unloading operations began. After all the materials had been

59. Clipping File, Cape Hatteras Beacon; Lighthouse Board, 5th District Engineer, Letter Press, 1857-1864, p. 159; Lighthouse Board, *List of Beacons Buoys and Daymarks in the Fifth Lighthouse District, 1900* (Washington: G.P.D., 1900), p. 111.

landed safely, a storm "of almost unparalleled severity" lashed the area and swept away most of the materials. What little survived was gathered together and sold to the Army nearby.

The Civil War interfered at this point, and the Lighthouse Board dropped the idea of constructing a lighthouse at Hatteras Inlet. Hatteras Inlet, however, grew even more important as an access, and by 1870, the Board acknowledged that it was "the best inlet leading to and from the sounds of North Carolina, with which there is a very large trade." The Lighthouse Service had marked the Channel through the inlet with buoys which was adequate for the daylight, but those vessels wishing to get through at night had to take a considerable risk if they dared pass through the inlet to or from the sound. No problem existed for steamers since they .they could adjust their speed to arrive off Hatteras Inlet during the day, but in the 1870's many, if not the majority, of the country's vessels were still under sail, and in view of the fact these ships had to take advantage of the wind, the captain of such a vessel could not predict at what time it might arrive off Hatteras Inlet.

Congress was not immediately responsive to the recommendation of the Lighthouse Board and for several years failed to make the needed authorization. Finally on March 3, 1873, Congress appropriated $18,000 for a screw pile lighthouse to be erected on Oliver's Reef

on the north side of Hatteras Inlet. It was to have a fifth order lens exhibiting a fixed red light.

After test borings on Oliver's Reef in January 1874 that revealed the foundation to be "clean, hard sand to a considerable depth," the Lighthouse Service contracted in March for the iron work and instructed the Lazaretto Island Lighthouse Depot in Baltimore to fashion the required wood work. The materials were collected in July and transported to Hatteras Inlet where work began immediately. Work was completed in September and on October 1, 1874, the light was exhibited for the first time. The light was red, but the lens was of the fourth order, a larger one than originally planned. The Lighthouse Board described the structure: "The lighthouse consists of a frame dwelling, square in plan, resting on a foundation of five solid wrought-iron piles, eight inches in diameter, which are screwed vertically into the shoal to a distance of about ten feet. The keeper's dwelling being surmounted by a lantern of the fourth order."
The dwelling was painted white, the blinds green, the roof and piles brown, and the lantern black. It stood in seven feet of water, and in addition to the light had a fog bell that struck every eight seconds.

In 1901 the lens was replaced which changed the characteristic of the light from flashing red every 30 seconds to flashing red every 20 seconds. Three years later the characteristic was changed once again, this time to fixed red. At the same time the workers suspended a fuel platform under the house by iron hangers.[60] The Light List through the years has continued to show the light on Oliver Reef in Hatteras Inlet.

THE CAPE HATTERAS LIGHT AND THE CIVIL WAR

With an extreme lack of foresight the Lighthouse Board reported in 1860: "…it is believed that the lighthouse establishment has about reached its maximum under our present limits, and that very few additional lights, no more perhaps than it may be found proper from time to time to discontinue, need to be added to meet all the just and reasonable wants of navigation."[61] Perhaps the great irony of this statement is that the Lighthouse Board felt they had a stable organization, but what they didn't know was that the country was on the verge of a tremendous catastrophe—a catastrophe

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60. Clipping File, Hatteras Inlet Light station. As a matter of passing interest, it may be well to note that the current Light List, as well as those for some years previously, show the light to have been established in Hatteras Inlet on Oliver Reef in 1905. Just how this error came about is not known, but the Light List for 1907 shows the establishment year as 1874.

61. Lighthouse Board, *Annual* Report, *1860* (n.t.p., n. p.), p. (1).

that was to have an important and direct effect upon the lighthouse establishment and its operation. Looming just ahead was the Civil War, and lighthouses from Cape Henry southward were to be taken over by the Rebels, not for the normal use of such objects, but with a view toward eliminating them from use by their enemy.

As the southern states seceded and Confederate troops moved to the shore, light keepers abandoned their lighthouses. Although the Confederacy provided for a lighthouse establishment within its government, it had little use for lighthouses as such, particularly while the war was on and while it had such a weak navy. Lighthouses were more beneficial to blockading ships than to blockade running ships.

Shortly after North Carolina seceded from the Union on May 20, 1861, state troops moved to the Outer Banks. They quickly took over the lighthouses, stopping their operation. The closing down of the Cape Hatteras light was noted especially 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."[62]

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62. *Frank Leslie's Illustrated Newspaper,* November 2, 1861, (No. 310, v. XIII), p. 375.

The Union forces in the early months of the war re-took the Outer Banks and became anxious to get the Cape Hatteras light exhibited again so, as a Federal officer reported in August l861, that it could "send forth its cheering ray to the storm beaten mariner…." But the Confederates had other ideas. The 3rd Georgia Infantry assaulted and routed the Federal troops in what became known as the Chicamacomico Races, and the commander, Colonel A. R. Wright, vowed, "We will demolish the light at Hatteras if we do no more." After beating a hasty retreat down the banks, the Federals stopped at Cape Hatteras, many of them sleeping on the ground around the lighthouse tower. Here they were re-enforced, mustered their courage, and counterattacked the Rebels; thus the lighthouse was saved from the same fate that befell the neighboring Bodie Island light tower.[63]

In the meantime agitation had begun to build up to get the Cape Hatteras light displayed once again. This light was extremely important to the coastal trade, a fact attested to by a letter to the Lighthouse Board dated September 21, 1861, "from the Presidents and Officers of the principal Insurance Companies of New York"

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63. *The War of the Rebellion: A compilation of the Official Records of the Union and Confederate Armies,* Series I, v. IV (Washington: Government Printing Office, 1892), pp. 585, 597; David Stick, *The Outer Banks of North Carolina* (Chapel Hill: University of North Carolina, c 1958), pp. 133-136.

petitioning the re-lighting of the Cape Hatteras light. "This is a very important point on our coast," they said, "and it is desirable the Light be re-established as speedily as possible."[64]

Shortly thereafter the Lighthouse Board moved to reestablish the light. The Secretary of the Treasury wrote the Secretary of the Navy that the Board planned to repair and re-exhibit the light at Cape Hatteras and requested that protection be given the light "from future injury or attack." The Navy issued instructions to the Flag Officer of the Blockading Squadron to provide all the protection he could from seaward. At the same time the Treasury Secretary made an identical request of the War Department, to which the Army replied: "The War Department will cordially cooperate with you in giving the proper instructions to the officers under its command in that region to do everything in their power to protect and secure the light from future injury or attack."[65]

In November W. J. Newman, Engineer of the war-time combined 4th and 5th Lighthouse Districts, visited the Outer Banks to examine the Cape Hatteras and Bodie Island lighthouses. He could not land at Bodie Island, and apparently made only a perfunctory examination of the Cape Hatteras· structure, for he reported, "We know that the

64. Treasury Department, Lighthouse Letters, 1860-6.1, P Series, pp. 188, 189.

65. *Ibid*, pp. 195, 202.

lens had been removed and probably most of the Lantern glass broken…." If he had indeed examined the lighthouse, certainly he would have had a more precise knowledge of its condition. At any rate the Chairman of the Lighthouse Board ordered Newman to visit Cape Hatteras in March with a view toward re-lighting the tower.[66]

The delay between the fall and the spring in taking action to get the Cape Hatteras light re-disp1ayed was obviously due to the fact that the Lighthouse Board felt that the territory was not yet free from incursion by the Rebels. In February 1862 the Secretary of the Navy transmitted to the Secretary of the Treasury a comment from the Flag Officer commanding the blockading squadron along the Outer Banks in which he said, "…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."[67]

Less than a week after the Secretary of the Navy transmitted this communication to the Treasury Department, the Secretary of the

66. Fifth District Engineer Letter Press, 1857-1864, Letters of December 7, 1861, February 5 and March 12, 1862; Francis R. Holland, Jr., "A History of the Bodie Island Light station" ([Washington]: Division of History, National Park Service, February 1967), p. 35.

67. Treasury Department, Lighthouse Letters, 1882-1864, Series P, p. 25.

Treasury instructed the Lighthouse Board to take the necessary steps to get the Cape Hatteras tower re-lighted. Like a typical government agency when receiving pressure from above, the Lighthouse Board did not want their superior to think it had been slothful, and accordingly it replied that it had sent a man to the Outer Banks in the fall of 1861, but his efforts had been fruitless. The Board then went on to recite the problems it would face in getting the light re-exhibited. First of all, there were mostly southern loyalists on the Banks, and those who had remained loyal to the Union were "too ignorant to be entrusted with the care of so important a Light Station…." Moreover, a military guard would be necessary, because when the Confederates heard the light was once again displayed, they would undoubtedly send marauders to destroy it. The Board asked the Secretary to request troops from the Secretary of War to protect the tower. Despite these difficulties, the Lighthouse Board said, it would go ahead with re-lighting the Cape Hatteras tower.[68]

On March 11, just three days after writing the Secretary of the Treasury, the Lighthouse Board ordered the 2nd, 4th, and 5th Lighthouse

68. Treasury Department, Lighthouse Letters, 1862-1864, Series P, pp. 4-5.

District Engineer, W. J. Newman, to see to the relighting of the Cape Hatteras light. Two days later Newman departed Philadelphia and on the 15th stepped off the L. R. Spaulding, an army transport, at Hatteras Inlet. The army unit there supplied him with transportation and an escort for his journey to the Cape Hatteras Light Station. At the station he discovered the light tower had been uninjured. The lens had been removed and, local rumor had it, taken to Washington, North Carolina, for storage. Only the lens was gone; everything else, including, the base plate, the revolving machinery, and the pedestal, were in place. This heavy equipment was a handicap, however, since it would have to be removed before a new lens could be installed. On close examination Newman found the tower to be in bad shape, not from the depredations of the confederates, but rather from the ravages of time. Cracks were beginning to appear in the sandstone of the tower, and they needed filling. The newer brick upper portion of the tower needed painting. The problem of erosion at the foundation was still present, and Newman recommended paving the area around the tower as had been previously contemplated and had actually been done at Cape Henry. This paving, he said, "must be done yet if the Tower is permanently retained…." Moreover, the tower stairs were wood "and most inconvenient, the windows defective &c &c." "It will become a question

to be settled shortly," he noted, "whether a new Tower would 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." He found the oil butts "so old and battered as to be unfit for further use." On the other hand the keepers' dwellings remained in good condition, and the principal problem in relation to them was the fact that high tides flooded the area between them and the tower, and as a result the keepers could not go between the structures without getting wet. Newman recommended that a plank walkway, or causeway, be laid.[69]

The Lighthouse Board authorized construction of the causeway, and in the middle of April ordered the Inspector of the 3rd Lighthouse District to ship a second order lens designed to have a characteristic of fixed varied by flashing light for the main tower, and a sixth order fixed lens for the beacon light. Newman felt there would be no difficulty fitting the fixed second order lens on the pedestal and base plate already in the lighthouse. The Board

69. Lighthouse Board, 5th District Engineer Letter Press, 1857-1864, pp. 157-160, 162 and letter dated March 12, 1862. In September 1865 the 5th District Inspector reported "recovery of Light-House apparatus supposed to belong to Cape Hatteras…." The Lighthouse Board ordered the Inspector to ship the lens to the depot in New York. See Lighthouse Board, Letters to 5th District Inspector, 1860-1871, p. 233.

also ordered new oil butts and the oil to fill them since the Confederates had reportedly removed all the oil.[70]

Newman had a crew in readiness in Philadelphia to go to Cape Hatteras to repair the lighthouse, but the lenses were abominably slow in arriving, due, undoubtedly, to the higher shipping priority war-goods received. In the meantime, New York and Philadelphia newspapers carried notices that the Cape Hatteras light had been relighted. This report, of course, was untrue, and its source was probably the Cape Hatteras beacon which had been temporarily relighted with a steamer's lamp. The lenses, however, finally arrived in Philadelphia on May 7, and two days later the working party departed for Cape Hatteras.[71] Just when the Cape Hatteras light was finally re-exhibited is not known, but it was probably around June 1, 1862.

70. Lighthouse Board, 5th District Engineer Letter Press, 1857-1864, pp. 168, 170, 173, 175.

71. Lighthouse Board, 5th District Engineer, Letter Press, 1857-1864, pp. 175-178,180, 188, 276; *37th Cong., 3rd Sess., Exec. Doc. No. 1* (Serial #1149), pp. 149,152. The activities of the working party are not known since they reported directly to the Lighthouse Board, and many of the records of the Board for this period were destroyed in the Commerce Department fire in the 1920's.

Interestingly enough, Newman once again requested an army detail to protect the lighthouse, giving as justification the following:

A new lens, "combining the latest and highest improvements," was ordered for the Cape Hatteras light and installed in 1863. The lens was a first order revolving one exhibiting a flashing light of five seconds duration and 15 seconds eclipse. The tower continued its white and red coloring, the first 70 feet of the tower being white and the remainder red.[72]

A NEW TOWER FOR CAPE HATTERAS

In 1864 the Lighthouse Board requested funds to replace the wooden stairs in the towers at Cape Hatteras and Cape Lookout.

> The L. H. Tower is removed some distance from the Dwelling. The stairway to the summit is nothing more than a series of heavy wooden ladders and landings, made of yellow pine and most inflammable. At the base of the Tower a large quantity of dry brush is always placed to keep the sand from blowing away. Any evil disposed person could in a few minutes, landing in the woods on the Sound Side, collect the dry stuff, fire the Stairway, and the man on watch at the top of the Tower would not have a chance to escape.

At the request of the Lighthouse Board the War Department agreed to supply a detail to protect the light station. But, whether troops were actually sent there is not known. See P. H. Watson to S.P. Chase, Washington, April 5, 1862, Treasury and Lighthouse Board, 5th District Engineer Letter Press, 1857-1864, p. 172.

72. *38th Cong., 1st Sess., House Exec. Doc. No.* 3 (Serial #1186), p. 156; Lighthouse Board, *Light List, 1866* (Washington: G.P.O., 1866), pp. 46-47.

Congress eventually responded with an appropriation, and when asked to comment on it, the 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 sandstone, he added, 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," he said, "and liable sooner or later to a disaster." Newman had apparently struck the proper chord, for in March 1867 Congress appropriated $75,000 for rebuilding the Cape Hatteras lighthouse.[73]

Unlike its predecessor in the administration of lighthouses, the Lighthouse Board did virtually no contracting work for actual construction of lighthouses. The Board built the lighthouses under the supervision of their foremen with day labor, and contracted for all materials needed. The Cape Hatteras light tower was no exception. The Lighthouse Board entered into a contract with Nicholas M. Smith of Baltimore to supply 1,000,000 "'prime dark red' brick at $12.35

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73. *38th Cong., 2nd Sess., House Exec. Doc. No.3* (Serial #1222), p. 167; *Lighthouse Laws and Appropriations, 1856-1869*, p. 38; Lighthouse Board, 5th District Engineer Letter Press, 1864-1867, p. 364.

per thousand, into one with Bartlett, Robbins and Co. to supply the metal to be used in construction, and into another with Beattie, Dawson &Co. to furnish stone for the foundation and steps. 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 [the Cape Hatteras tower] shall be of as durable a character as the nature of the materials out of which it is built will admit, and that in the construction nothing be omitted which will tend to give it such a character." The Board also entered into an agreement with Lennox and Burgess of Philadelphia to transport all materials to Cape Hatteras. Ships were to take the materials to the entrance to Cape Channel in the sound, just behind Cape Hatteras where it would be lightered to the shore and then carried by tramway to the construction site.[74]

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74. Lighthouse Board, Letters to 5th District Engineer, 1868-1873, pp. 2-3; Abstract of Miscellaneous Contracts, 1841-1875, pp. 70, 98; Lighthouse Board, 5th District Engineer Letter Press, 1867-1869,

At first the Lighthouse Board contemplated building a tower so that the focal plane of the light would be 150 feet above the sea, "the ordinary altitude of first-order towers." Before long the Board changed its mind and ordered the tower to be constructed so that the focal plane of the light would be 180 feet above the ground. The reason given for this change was "the interests of commerce," which probably meant that it was desirable that the light be seen the additional distance the extra height would permit. Of course, the added height necessitated an additional appropriation.[75]

On October 19, 1868, the working party, "with a complete outfit for carrying on operation," departed Baltimore for Cape Hatteras, where they were to receive the first batch of brick, erect necessary sheds and "prepare the heavy grillage for the foundation." The District Engineer selected Dexter Stetson to be foreman, and under his supervision the tower was to be constructed. The crew arrived

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pp. 292-293, 344, 345, 379; Lighthouse Board, Letters to 5th District Engineer, 1868-1873, pp. 3, 10, 44, Lighthouse Board, *Annual Report, l868* (Washington: G.P.O., 1868), p. 48. Nicholas M. Smith was later to supply the brick used in the neighboring Bodie Island light tower. See Holland, "The Bodie Island Light Station," p. 49. The tramway, of the "Peteler pattern," was subsequently used in constructing the Bodie Island tower. See *Ibid,* p. 38 and Lighthouse Board, *Annual Report, l868,* p. 48.

75. Lighthouse Board, *Annual Report, l868* (Washington: G.P.O., 1868), p. 48.

at the Cape on November 4 and immediately went about building the facilities they needed to properly undertake the construction work. In the meantime Stetson rented a house on the beach where the work crew could live until they could complete their barracks. Stetson and his crew went about their work with a will, and their accomplishments were summed up in the *Annual Report* as follows:

> Suitable buildings for workmen's quarters and messroom were erected; a blacksmith shop 'built; a house in which to store cement and other perishable materials put up; two derricks erected; a wharf built on the south side of the island, distant 1¼ miles from the station, this being the nearest point accessible to the scow lighters; two decked scows and one open one, built to serve as lighters, and a small boat and crane on wharf for unloading heavy stone. Also, a tram railway, of Peteler's design, laid from the wharf to the light house, upon which to transport materials.[76]

As this work was progressing at Cape Hatteras, problems were arising in Baltimore over getting materials to the workers. Lennox

76. Lighthouse Board, *Annual Report, 1869* (Washington: G.P.O. 1869), pp. 46-47; Lighthouse Board, 5th District Engineer Letter Press, 1867-1869, pp. 339, 377-378, 387, 389. A minor flap occurred in the selection of a foreman. Somehow the word circulated that W.J. Humes was to be superintendent of construction of Cape Hatteras. Several veterans of the Union army wrote protesting the appointment, charging Humes with cruelty at a Richmond prison. Humes denied the allegation, saying that all he had done was build some brick ovens at the prison. Newman said the whole question was academic since he had no intention of hiring Humes; he had another man in mind. See *Ibid.,* pp. 331-332.

and Burgess, contractors who had agreed to transport the materials to the site, apparently entered the agreement without any vessels available they could use. In early November they wrote to the District Engineer that they were looking for ships and would pick up the materials a few days after November 10. This pick-up date was cutting it rather fine since Lennox and Burgess had agreed to deliver the brick to Cape Hatteras by the 15th. But apparently whatever arrangement the contractors thought they were about to make fell through, for on November 24 the District Engineer wrote them expressing concern at the delay, saying that there is "a large number of men engaged at Cape Hatteras, who will soon have nothing to do but eat the rations furnished by the Government…."

Finally in December Lennox and Burgess chartered the schooners L. Sturdevant and Joel Vanzant. Shortly afterwards they chartered another schooner, the Trenton. During the month the first two vessels were loaded, and December 28 the lighthouse material was finally enroute to Cape Hatteras.[77]

With the arrival of materials at the Cape, work began in earnest on the tower. The first step was getting an adequate foundation. The site selected for the tower was 600 feet northeast of the old tower

77. Lighthouse Board, 5th District Engineer Letter Press, 1867-1869, pp. 386, 390, 396, 407-408, 413-414.

and on the same general level of beach. This site was selected because it was "secure from the destructive action of the wind, which had always so seriously threatened the foundations of the old tower…." Newman had selected the site when he was District Engineer, but it had not been approved by the Lighthouse Board. The Board discovered this oversight towards the end of April after the work crew had done considerable work on the foundation. Simpson, the current District Engineer, was unaware that the Board had failed to act on the site, but nevertheless he defended Newman's choice, both on the grounds that the site would not be subject to erosion and that the new location was so close to the old one that sailing directions would not have to be changed. The Board apparently felt this light was so important that they could not make a decision on the District Engineer's recommendation alone as they would normally have done, for they sent a committee to Cape Hatteras during the second week in May, and at that time the site was approved.78

From the point of view of the foundation, Newman had selected a good site. The Lighthouse Board instructed the District Engineer

78. Lighthouse Board, 5th District Engineer, Letter Press, 1867-1869, pp. 540-544, 572, 592; Lighthouse Board Letters to 5th District Engineer, 1868-1873, pp. 18, 20; Lighthouse Board, *Annual Report, 1869,* p. 47.

to make a test boring to 20 feet in order to determine the nature of the foundation soil at the tower site, but the Superintendent of Construction, Dexter Stetson, found that he could drive a sounding rod only nine feet into the ground. After cleaning out a pit six feet deep he found also that he could drive piles only six feet deeper, "the sand being very hard and compact." In view of such a solid bottom he requested and received permission to dispense with using piling for the foundation. Stetson and the workmen proceeded to lay layers of six-inch by 12-inch yellow pine timbers, placed crossways on top of each other. The task was complicated by the fact that the pit was below the low water level, and water seeped in, but Stetson resolved this problem by throwing up a coffer dam and keeping the pit pumped out with "powerful steam pumps." Being below the low water level, the foundation timbers were always assured of being immersed in water, thus enhancing preservation of the wood. "Upon these timbers," the Lighthouse Board later reported, "is 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."[79]

79. Lighthouse Board, *Annual Report, l869,* p. 47; Lighthouse Board, Letters to 5th District Engineer, 1868-1873, pp. 14, 17; Lighthouse Board, 5th District Engineer Letter Press, 1867-1869, pp. 482, 501, 506-507, 657; Dexter Stetson to J. H. Simpson, Cape Hatteras, April 4, 1869, J. H. Simpson to Dexter Stetson, Baltimore,

When the stone part of the foundation was completed, work continued with the laying of stone and brick for the base of the tower which began with the laying of "octagonal plinthe [sic] courses of cut granite." Work was hampered and delayed by the loss of shiploads of brick and the overturning of a lighter filled with stone. The District Engineer had hoped that the 'base would be completed by the second week in October, but by the first of October 1869 the workmen had reached only the ninth quoin, about the top of the entrance doorway. Nevertheless the lighthouse had begun "to assume a very handsome, solid and imposing appearance." Around the middle of October the District Engineer wrote the stone supplier asking where the stones were for the crowning courses of the base. As it turned out the stone had been shipped a few days previous to the Engineer's letter, and apparently not long afterwards it arrived at Cape Hatteras, for Stetson reported on November 30 that the workmen had finished the base and the masons were standing by to begin laying the brick for the tower.[80]

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April 13, 1869, and J. H. Simpson to W. B. Shubrick, Baltimore, April 21, 1869, in Clipping File, Cape Hatteras Light Station.

80. Lighthouse Board, *Annual Report, 1869,* p. 47; Lighthouse Board, *Annual Report, 1870,* p. 36; Lighthouse Board, 5th District Engineer Letter Press, June 1869-0ctober 1869, pp. 118-119, 299-300; Lighthouse Board, 5th District Engineer Letter Press, October 1869-May 1870, pp. 10, 109.

From time to time, problems not of the lighthouse builders own making further hampered construction. The first problem that arose centered around the failure of Lennox and Burgess to provide on schedule the ships needed to transport the materials to Cape Hatteras. Finally they were able to secure ships and the materials began to flow southward with some regularity until February 19, 1869, when the schooner Ida Nicholson loaded with 101,600 bricks, sundry food for the men, and feed for the animals, went down in a severe gale just eight miles from the lighthouse. The loss of the food was especially distressing, and two weeks later the District Engineer wrote Lennox and Burgess urging them to get another ship since the men at Cape Hatteras were out of provisions. Lennox and Burgess did not respond rapidly, and the District Engineer, feeling the situation at the Cape was getting desperate, chartered the Mary Mizell, loaded it on March 10 with provisions and cement, and dispatched the vessel to Cape Hatteras. Meanwhile, another vessel laden with stone had arrived at the construction site. While unloading the ship, one of the lighters overturned as the result of strong winds and eight blocks of cut granite were lost in five feet of water. Since reordering the stones would not only be expensive, but would also cause a considerable delay, the District Engineer instructed Stetson to attempt to retrieve them. It is not known whether he was able to do so or not, but

presumably he did since there is no indication that anyone ordered additional stones.

In the meantime, the District Engineer continued to wage a constant battle to get Lennox and Burgess to send ships to pick up the supplies and materials destined for Cape Hatteras. It must have been terribly frustrating to the District Engineer to have to prod the contractors. The fact the Lighthouse Board let the contractors get away with such a poor performance does not speak well for that august body. Apparently as a result of the slowness of the Trenton in getting to Baltimore to pick up supplies, the Board gave the District Engineer permission to charter vessels under special circumstances. The Trenton was over a month late in getting to Baltimore. At least one other time, in December 1869, Lennox and Burgess were so slow in getting ships to Baltimore to pick up bricks that the District Engineer had to charter vessels to get the materials to Cape Hatteras so that work on the tower would not be slowed. In early August another minor catastrophe struck when the J. Parker, loaded with 50,000 bricks for the light tower, went ashore at Nags Head; both ship and cargo were a total loss.[81]

81. Lighthouse Board, 5th District Engineer Letter Press, 1867-1869, pp. 456, 460, 461,465, 467-469, 488, 509-549, 551-552; Lighthouse Board, 5th District Engineer Letter Press, June 1869-1868-1873, pp. 14, 19; Lighthouse Board, 5th District Engineer Letter Press,

Other problems arose during the construction, such as the rapid wearing of the car wheels on the tramway due to the sand, but the most serious one was the same problem that plagued the builders of the original lighthouse: sickness. The workmen suffered so from illness that five had to leave Cape Hatteras in early August of 1869, delaying the progress of work. Because of the sickness the District Engineer took Colonel James Simons, a Surgeon, on his August inspection trip to Cape Hatteras. After examining the men Simons recommended a daily issue to each man of 1½ ounces of whiskey and 5 grains of quinine to prevent intermittent and remittent fevers. Whether the prescription was ever filled is not known. Authorization from the Lighthouse Board was needed to issue whiskey to workmen since it was the first time the question had been raised, and the Lighthouse Board was not scheduled to meet until the first week in September.[82] None of those on full-time duty, such as the Engineering Secretary or the Naval Secretary, wanted to

October 1869-May 1870, pp. 105. The Board's concern over this lighthouse was further evidenced when one of the stones to be used in the cornice of the base broke while being worked on at the quarry. The decision whether to use the stone or not was made by the Lighthouse Board, not the District Engineer. The Board gave explicit instructions on how the stone would be used. See Lighthouse Board, Letters to 5th District Engineer, 1868-1873, pp. 40, 42-43.

82. Lighthouse Board, 5th District Engineer Letter Press, June 1869-0ctober 1869, pp. 46, 118, 134-135, 173-174, 189.

make such a decision. For all of the technological advance the Lighthouse Board brought to aids to navigation, in its administrative procedures the Lighthouse Board could be terribly conservative and bureaucratic. Probably by the time they did pass on the question, the sickly season at Cape Hatteras had run its course.

The construction foreman thought, and probably rightly so, that at least one of the causes of the sickness was the pond of stagnant water that stood under the house of the keeper. Stetson reported that for years the light keepers had been throwing offal and other waste from the kitchen and elsewhere into the pond. The whole area was an unsanitary mess that Stetson felt would emit a powerful odor when the pond dried up during June and July. As a remedy he recommended draining the pond and using sand as fill around and under the house. The District Engineer concurred in this recommendation and passed it on to the Lighthouse Board. The Board, however, did not agree that draining the pond would be beneficial and said, "The ill effects of the stagnant water may possibly be overcome by filling up the pond and particularly that portion under and near the dwelling, with sand or any debris, such as broken stone or brick that may be at hand."[83] Stetson took the necessary action,

83. Lighthouse Board, Letters to 5th District Engineer, 1868-1873, pp. 32, 33; Lighthouse Board, 5th District Engineer Letter Press, 1867-1869, pp. 50, 685-687; Lighthouse Board, 5th District Engineer Letter

but the filling in of the pond did not immediately solve the sickness problem since the Board issued its suggestion in late June, and in August the workmen became sick anyway.

Later in the year the Lighthouse Board entered into contracts to supply other materials needed in the construction of the light tower. They contracted with Bartlett, Robbins &Co. to supply the oil tanks for the tower. The firm was to make these tanks of 5/16" boiler plate (wrought iron) and line them with high grade tin. For this contract Bartlett and Robbins bid $17,583 and agreed to deliver the materials by the middle of February 1870. The Board also entered into a contract with Hazlehurst &Co. to supply the metal castings and bronze hinges needed in the tower. The castings consisted of lintels, door jambs, imposts, sills, floor plates, steps for oil recesses, stair guards for the oil recesses, wall holders for the stair stringers, and composition hinges and nuts.[84]

During the year the 5th District Engineer, J. H. Simpson, took the lead in attempting to get the post office re-established at

Press, June 1869-0ctober 1869, pp. 35-36. All this time a committee from the Lighthouse Board found the keeper's quarters to be in "wretched condition" and would require repairs costing about $1,000. The Lighthouse Board authorized the repairs.

84. Lighthouse Board, Letters to 5th District Engineer, 1868-1873, pp. 55, 57-58; Lighthouse Board, 5th District Engineer Letter Press, June 1869-0ctober 1869, pp. 83, 198, 275; Lighthouse Board, 5th District

Cape Hatteras. One had not been there since the beginning of the war. In July Simpson wrote the Postmaster General saying that the lighthouse establishment suffered much inconvenience due to the absence of a post office at Cape Hatteras. To get the mail to the construction crew at Cape Hatteras the District Engineer had to make arrangements with a W. A. Smith to carry it from New Bern to Hatteras Island. The government was building a larger lighthouse there with the consequent employment of a greater force, he pointed out. Moreover, there were 1,000 to 1,500 inhabitants already on Hatteras Island. Simpson learned that the steamers, the Ellen Terry and the Louisa Moore, made weekly runs between New Bern and New York and stopped at Hatteras. He wrote the agents for these two vessels asking them to submit a bid to carry the mail to Cape Hatteras. Evidently Simpson had little success with his own efforts, and in October he forwarded to the Lighthouse Board a petition from the people of Hatteras Island requesting a post office. Simpson hoped the Board would endorse the petition before sending it to the Post Office Department.[85]

Engineer Letter Press, October 1869-May 1870, pp. 48, 65; Lighthouse Board, Annual Report, 1870, p. 36.

85. Lighthouse Board, 5th District Engineer Letter Press, June 1869-October 1869, pp. 20-21, 43-44, 175, 296-297. Just how successful Simpson was is not known at present. The 1870 *Postal Guide* does not

By the end of 1869 the workmen had completed the base and had laid three courses of brick on the tower. By the middle of January the District Engineer reported that the tower now reached 25 feet above the first floor, and a month later the workmen attained the second landing. Two weeks later the tower was 50 feet above the first floor. Toward the end of March the first two flights of stairs were shipped to Cape Hatteras, and by the end of April were installed. By this time the tower was 97 feet above the ground, and the District Engineer gleefully reported that the "batter and rotundity of the tower…have been admirably preserved." By this time four flights of stairway had been placed. On June 16 the tower had been completed to 153½ feet, which would be just about where the bottom of the supports of the lantern are now. At this point Stetson halted work because of necessary alterations in the lantern iron work, and the foreman sent home all but six of the workmen, who remained as watchmen.[86]

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list a post office for the Cape Hatteras area. However, *List of Post Offices in the United States and Canada, l873* (Washington: William H. Boyd, 1873) p. 129, shows a post office for Hatteras.

86. Lighthouse Board, 5th District Engineer Letter Book, October 1869-May 1870, pp. 166, 190, 299, 309, 355, 442; Lighthouse Board, 5th District Engineer Letter Book, May 1870-November 1870, pp. 14, 64.

Another reason for the suspension of the work was the delay by the contractor in making the iron work for the inside of the tower. Finally, on September 9 Bartlett and Robbins completed casting the seventh flight of stairs and shipped it to the Cape. On the following day the District Engineer dispatched a working party to Cape Hatteras, and work resumed on the tower. Two and a half weeks later the contractors shipped the remaining iron work for the top of the tower, except for the lantern, and work progressed nicely. By the first week in November the capital of the tower was ready to receive the lantern and lens. Bartlett and Robbins completed the lantern and shipped it to Cape Hatteras around the middle of November.[87]

Originally the Lighthouse Board thought that it would use the lens in the old tower for the new tower. In fact on May 13, 1870, as completion of the tower was in sight, the District Engineer sent his assistant to Cape 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

87. Clipping File, Cape Hatteras Light Station, North Carolina; Lighthouse Board, 5th District Engineer Letter Book, May-November 1870, pp. 226, 295, 356-357.

Board said it had on hand a first order flashing lens with pedestal. Simpson was elated over this prospect and quickly replied he wanted the new lens. The Board accordingly shipped it to him, and he received it around the middle of June. The Board also sent him the plans for the lighting apparatus in the Point Reyes, California, light tower since the two were quite similar in design and operation. Simpson sent the lens on to Cape Hatteras, after the lantern makers in Baltimore had examined it to see whether they should make any a1terations in the lantern to accommodate it. Some minor ones were necessary. On November 19, the District Engineer ordered the District lampist, George J. Crosman, to Cape Hatteras to set up the lens and take down and pack the old one for shipment to the lighthouse depot on Staten Island, New York, where it was to be stored, reportedly for later use at Alligator Reef. Crosman installed the lens and exhibited the light for the first time on September 17, 1870. The new lens and revolving machinery worked well, and the 1ampist took down the old lens.[88]

88. Lighthouse Board, *Annual Report, 1871,* p. 33; Lighthouse Board, Letters to 5th District Engineer, 1868-1873, pp. 84-85, 90, 117; Lighthouse Board, 5th District Engineer Letter Book, October 1869-May 1870, pp. 459, 483; Same, May-November 1870, p. 26; Same, November 1870-May 1871, pp. 3, 6, 207-209. The Assistant District Engineer was instructed to tell Stetson to run a ¾" copper rod down the tower's well hole to a point at least two feet below the foundation of the tower. This lightning conductor was to be riveted to the stairs.

In the meantime the workmen were putting the finishing touches on the tower. They erected an iron fence with a granite base that the District Engineer had recommended to keep cows and pigs out and to prevent erosion. They whitewashed the interior of the tower. The exterior of the tower, the Board felt, should conform in appearance to the old tower; consequently, the Board decided to leave the base of the structure its natural color since the dominant material was granite and therefore would appear white when viewed from the sea against the background of green woods. The brickwork, the Board felt, should be covered with a brick-colored cement wash to protect it from wind erosion. Afterwards the work crew painted the ironwork, including the lantern and stairs. Thus was completed the highest brick lighthouse tower in the world.[89]

With the completion of the new tower there no longer was a need for the old one, and since it was in imminent danger of collapsing in a heavy storm, the Lighthouse Board decided to raze the old tower. On February 16, 1871, the District Engineer reported the Cape Hatteras tower had been blown up. He said, "Three mines were fired almost

89. The *Annual Report* of the Lighthouse Board for 1871 said that the light on the new tower was exhibited for the first time on December 16; the monthly report of the District Engineer says the 17th. Light-House Board, *Annual Report, 1871* (Washington: G.P.O., 1871), p. 33; Lighthouse Board, Letters to 5th District Engineer, 1868-1873, pp. 44-45, 101; Lighthouse Board, 5th District Engineer Letter Book, June 1869-

simultaneously blowing out a large wedge on the side toward the beach & this old land mark was spread out on the beach a mass of ruins."[90] It is not known what was done with the stone and such from this tower. Perhaps some of it was transported to Bodie Island for use in the lighthouse there; the District Engineer considered that possibility at least at one point. The demolition crew removed all iron prior to the destruction of the old tower, however, and shipped it to the depot near Baltimore to be sold.[91]

THE KEEPER'S DWELLING AND END OF CONSTRUCTION

In November 1870 as the tower was nearing completion the District
Engineer requested permission of the Lighthouse Board to use some brick and lumber at the site to erect a keeper's quarters consisting

October 1869, p. 56; Same, October l869-May l870, pp. 375, 492; Same May-November 1870, p. 366; Same November l870-May l871, pp. 6-S, 60, 152, 209-210. See also Lighthouse Board, *Annual Report, 1870,* p. 36. The District Engineer ran a transit line and established the focal plane of the light at 190.89 feet above mean low water. He reported also finding that "the bottom of the grillage foundation (to be) 3.89 feet above mean low water or about one & one half feet above high water." See Lighthouse Board, 5th District Engineer Letter Book, November l870-May l871, pp. 349-341.

90. Lighthouse Board, *Annual Report, 1871,* p. 33; Lighthouse Board, 5th District Engineer Letter Book, November l870-May 1871, p. 332.

91. Lighthouse Board, 5th District Engineer Letter Book, November l870-May 1871, pp. 210-211, 326, 479. In 1903 Lee de Forest, father of television, wanted to erect a wireless telegraph station at Cape Hatteras

consisting of four rooms and a kitchen. He said that the present keeper's dwelling was adequate for only two families, not for three as was assigned to Cape Hatteras. The Board evidently assented to this request; for two weeks later the District Engineer sent the construction foreman at Cape Hatteras plans for a dwelling of the same design as the one at Leading Point "to be located…a short distance east of the present dwelling, its front on the same line as the front of that and about in the rear of the Superintendent's or workmens quarters." The building was to cost $3,600.[92]

Construction of the building evidently began shortly after Stetson received the plans, for by the end of December the first floor of the structure had been laid, the doors and windows set, and the brickwork carried up five feet: A month later the brickwork had been finished and carpenters had begun putting on the roof. During February the dwelling was "shingled, lathed and plastered

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and asked to buy the stones from the foundation of the old tower. He wanted to use the stone in making cement for his station. De Forest's request ran afoul of government regulations which stated that government property had to be sold at public auction. See Engineering Secretary to Lee de Forest, Washington, February 28, 1903, and Engineering Secretary to 5th District Engineer, February 11, 1903, File No. 860.

92. Lighthouse Board, 5th District Engineer Letter Book, May-November 1870, p. 381; Same, November 1870-May 1871, pp. 7-8.

and the floors laid." The workmen completed the structure in March and constructed a wooden picket fence partially around the building. The fence was completed when the workmen's quarters was removed; In addition the work crew laid a board walk from the keepers' quarters to the tower. Although originally requested for the use of the third keeper, the Lighthouse Board assigned the dwelling to the principal keeper.[93]

Construction work at Cape Hatteras ended. The job now was to clean up the mess and transport usable materials to Bodie Island for use in construction of the new light tower there. In the middle of March the District Engineer instructed Stetson to remove all workmen from Cape Hatteras except the ones needed to guard the materials left there. The materials were not shipped immediately to Bodie Island because of the delay in transfer of ownership of the land there to the government; the transfer was not consummated until June 13. In June 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

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93. Lighthouse Board, 5th District Engineer Letter Book, November 1870-May 1871, pp. 210, 327, 479, 583-584; Lighthouse Board, *Annual Report, 1871,* p. 33.

arrived on Bodie Island and began the erection of the buildings,[94] indicating that Cape Hatteras was pretty well cleaned up by this time.

THE LIGHT STATION, 1872-1900

Not long after the workmen put the finishing touches on the tower the Lighthouse Board decided that the brick-colored wash did not make the tower a distinctive enough daymark. 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." The District Engineer sent in his study incorporating the Board's suggestion and on March 25, 1873, the Board approved painting the tower with black and white spiral stripes. In the meantime the Board had also approved painting the Cape Lookout tower in black and white checkers. Consequently, they ordered that both light towers be painted at the same time so that only one notice to mariners need be sent out. The painters finished both lighthouses,

94. Holland, "Bodie Island Light Station," pp. 38-39; Lighthouse Board, 5th District Engineer Letter Book, November 1870-May 1871, pp. 325, 459, 583-584; Same, April 1871-September 1871, p. 608; Lighthouse board, Letters to 5th District Engineer, 1868-1873, p. 183.

and the Board felt the Cape Hatteras tower was now "a better day-mark on this low, sandy coast."[95]

In the subsequent years improvements and additions were made to the lightstation to meet changing conditions, and, of course, the station received routine maintenance. In 1874 the Lighthouse Board 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.

The following year the Lighthouse Board decided to experiment with the use of the English wicks to see if they used less oil, and

95. Lighthouse Board, Letter to 5th District Engineer, 1868-1873, pp. 393, 403; Lighthouse Board, *Annual Report, 1873* (Washington: 1873), p. 48. There is the belief by some on the Outer Banks that the painter of the two light towers, Cape Hatteras and Cape Lookout, made a mistake and reversed the designs of the towers. They contend that actually the Cape Hatteras tower was to have been painted with the diamond pattern because of the proximity of that tower to the Diamond Shoals. There is absolutely no truth in the story. From the beginning the Lighthouse Board intended painting the Cape Hatteras tower with stripes and the Cape Lookout with checkers, or diamonds. See also F. Ross Holland, Jr., "A Survey History of Cape Lookout National Seashore" ([Washington;] National Park Service, 1968), p. 31.

they chose the Cape Hatteras tower as one of the lights in which to test the wicks. In 1877 the station lost its boat when the Lighthouse
Board felt one was no longer needed there. In 1882 the Board authorized the replacement of the call bells between the tower and the keepers' dwellings, and five years later they had to be replaced again. In 1883 the 5th District Inspector was called upon by the Board to explain why the Cape Hatteras light had used 27 gallons of oil over its quota during the second quarter.[96] In 1888 two new storehouses, 10' x 12', were added to the station, as was a small structure near the tower for the storage of empty oil cans. Moreover, 400 feet of new fencing was installed.

The fuel ration for the Cape Hatteras Light Station was two tons of coal and 12 cords of wood annually. For some years the coal needed for the stove in the watch room was simply dumped on the ground near the tower. In 1884 the District Inspector visited the station and noting the lack of storage for the coal recommended that a bin holding three or four tons be built near the new tower.

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96. Lighthouse Board, 5th District Engineer Letter Book, January-July, 1874, p. 444; Engineer Secretary to 5th District Engineer. October 25, 1882, Lighthouse Board, Letters to Engineer, 5th District, July, 1880-June 30, 1883; Engineer Secretary to 5th District Engineer, April 16, 1887, and October 10, 1887, in Lighthouse Board, Letters to Engineer, 5th District, January 1, 1887-June 30, 1888; Lighthouse Board, Letters to 5th District Inspector, 1874-1881, pp. 99, 160; Same, 1881-1885, p. 272; Lighthouse Board, *Annual Report, 1888,* (Washington: G.P.O., 1888), p. 86.

The Board immediately saw the need for such and authorized the District Engineer to construct the bin.

Three years later, in 1887, the District Inspector recommended that an oil-house be added to the station. At that time the keepers stored the oil in the recesses in the base of the tower and in a wooden fuel shed.

Also at this time the Board urged construction of a dwelling for the 3rd assistant keeper, who then was living in the assistant keepers' double dwelling which meant that three families occupied a dwelling meant for two. The Inspector said, "As each of these men has a family ranging from three to seven persons, it will be seen that they are much too crowded for either health or comfort." As a result of the Inspector's recommendation the Lighthouse Board asked Congress for $5,000 to build the two structures. But Congress did not respond favorably, and the Lighthouse Board renewed the request each year until 1891 when Congress finally heeded it. In January 1892 the Lighthouse Board gave the District Engineer authorization to go ahead with construction of the dwelling and oil house. Instead of building a new structure the District Engineer had the assistant keepers' dwelling expanded. What was done was summed up in the *Annual Report:*

> One of the kitchens forming the wings of the assistant keepers' dwelling was moved to the rear, and changes were made to adapt it to the use of two families.

> The main building was extended on its front and back lines about 16 feet; the inclosure constituted an addition 16 feet by 20 feet 3 inches in plane and two stories in height. This provided comfortable quarters for the assistant keeper in charge of the Cape Hatteras Beacon, whose previous accommodations were scant.

In addition, the Board reported erecting a brick oil house "15 feet 6 inches by 13 feet 6 inches in plan, with wall 8 feet 6 inches high and 9 inches thick, and a gable roof 4 feet high." Further activity during the year included moving one of the storehouses from near the tower to the principal keeper's house and the putting "in complete order" of both the principal keeper's dwelling and the old parts of the assistant keepers' dwelling.[97]

The Cape Hatteras tower experienced two potentially dangerous natural phenomena: lightning and an earthquake. On April 17, 1879,

97. Ledger of allowances of Fuel and Rations to Lighthouses, Light Vessels, and Tenders, p. 46; Lighthouse Board, Letter to 5th District Inspector, 1871-1873, p. 175; J. E. Walker to F. H. Baker, July 7, 1874, Lighthouse Board, Letters to Inspectors, 5th Lighthouse District, July 6, 1874-June 27, 1877; Naval Secretary to 5th District Inspector, November 24, 1884, Lighthouse Board, Letters to Inspectors, 5th District, January 2, 1884-June 30, 1885; Naval Secretary to 5th District Inspector, July 6, 1887, Lighthouse Board, Letters to Inspectors, 5th District, January 1, 1887-March 31, 1888; Lighthouse Board, Letters to 5th District Inspector, 1881-1885, p. 459; Engineer Secretary to 5th District Engineer, November 24, 1884, Lighthouse Board, Letters to Engineer, 5th District Engineer, May 23, July 8, 1887, Letters to Engineer, 5th District, January 1, 1887-June 30, 1888; Engineer Secretary to 5th District Engineer, January 16, 1891, and January 7, 1872, Lighthouse Board, Letters to Engineer, 5th District, July 1, 1890-June 29, 1892; Lighthouse Board, *Annual Report, 1887* (Washington: G.P.O., 1887), pp. 17, 49-50; *Annual Report, 1888,* p. 86;

lightning struck the tower and two months later the keeper reported cracks running up it. The Lighthouse Board was not concerned greatly by the cracks, feeling the tower was in no danger. However, it was concerned about further damage from lightning, and deciding that the damage was "due to imperfect connection of the iron-work of the tower with the earth," 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.

Seven years later the tower was rocked by an earthquake. The quake occurred on August 31, 1886, and apparently was centered in the vicinity of Charleston, South Carolina, since that was the area hardest hit. The effects of the quake, however, were felt all along the east coast and a number of lighthouses were shaken. What happened at Cape Hatteras was summed up by the Lighthouse Board:

> The keeper reports that he felt an earthquake shock on August 31, at 9.50 p.m., local time. The shock lasted from ten to fifteen seconds. It was accompanied by a rumbling noise. There were four shocks. They were severe enough to slightly crack the storm panes in the lantern tower. The second shock occurred at 10 o'c1ock, lasted about 6 seconds, and was very light. The third

Annual Report, 1889, pp. 92-93; *Annual Report, 1891*, p. 90; *Annual Report, 1892*, p. 96. In 1894 the Lighthouse Board decided to display the United States flag at each light station and ordered erection of flag poles 80 feet tall. See Lighthouse Board, *Annual Report, 1894*, (Washington: G.P.G., 1894), pp. 32-33.

shock occurred at 10.07, lasted about ten seconds, and was moderate. The fourth shock occurred at 10.29, lasted about six seconds, and was very light. Its force was sufficient to set suspended objects swinging and to overthrow light objects. He further states that it sounded like a rumbling noise coming up the tower.

'Then [the keeper reported] the tower would tremble and 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.'

On September 3 another slight shock was felt at 11.05 p.m., which lasted about three seconds.

The records do not indicate that any structural damage resulted from the quake.

PERSONNEL

One of the principal aims of the Lighthouse Board when it was first constituted was to establish a professional organization of well-trained keepers. The Board especially wanted lightkeepers to be proficient and responsible men. They wanted a Service in which men could make a career, rising from the lesser positions to that of principal keeper. For too many years the lighthouse service had

98. Engineer Secretary to 5th District Engineer, June 14, 1879, February 5, 1880, and February 10, 1880, Lighthouse Board, Letters to Engineer, 5th District, July 3, 1877-June 30, 1880; Lighthouse Board, *Annual Report, 1886* (Washington: GoP.Oo, 1886), p. 139.

been a refuge for the political hack. Indeed, one writer commented in 1874: "…the petty though important place of light keeper has too often been made a political prize, and thus the service, which requires permanence, has been injured. The politicians of the baser sort have not seldom defeated the best intentions and desires of the [Lighthouse] Board, and ousted a good man to put in one useful at the polls."

As time went on, the Board's dream came closer and closer to reality. Civil Service reform legislation of 1871 and 1883 gave impetus to achievement of the Board's desire. By 1899 they could, undoubtedly with much satisfaction, write to their District Engineers:

The Board invites your attention to the rules for the government of Local Civil Service Boards, and requests you to take the proper steps to have eligible lists established in your District, so that, whenever vacancies occur in any positions coming under the jurisdiction of the Local Civil Service Boards, you will have a list from which to nominate a suitable successor.

Even before this order, however, keepers had begun to transfer about from lighthouse to lighthouse as more responsible jobs became available, and from year to year transfers occurred with increasing frequency. As a result of this increased professionalization the keepers gained reputations for reliability, especially at Cape Hatteras. On several occasions, for example. Professor S. F. Baird, U. S. Commissioner of Fish and Fisheries. called on the Cape Hatteras

keepers to keep data on fishes and water temperature, in order to determine the effect of water temperature upon American fisheries, and the American Ornithological Union asked the keepers in 1884 to keep records on shore birds. In 1896 the Lighthouse Board sent the principal keeper, Tillman F. Smith, to the Atlanta Exposition to serve as a representative of the Lighthouse Service at their exhibit.[99]

One of the more intriguing keepers at the Cape Hatteras station was A. W. Simpson. When Professor Baird first approached the Lighthouse Board about the Cape Hatteras Light Station recording data for his Commission, he specifically requested that Assistant Keeper A. W. Simpson be the collector of the information. This request indicates, of course, that Simpson had impressed Baird as having a special aptitude, and perhaps interest, in this sort of work, and a bent toward more intellectual activities than the routine of lighthouse keeping. In time Simpson left the Lighthouse Service, but he returned to the work in 1892 when he received an appointment

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99. Lighthouse Board, Letters to Engineers, 5th District, July 1, 1898-December 31, 1899; Lighthouse Board, Letters to 5th District Inspector, 1874-1881, pp. 36, 251; Same, 1881-1885, p. 348; Naval Secretary to 5th District Inspector, January 20, 1896, in Letters to Inspector, 5th District, July 1, 1895-December 31, 1896; Charles Nordoff, "The Lighthouses of the United States," *Harper's Magazine,* 38 (March 1874), 477.

as 3rd assistant keeper at Cape Hatteras. The years either wrought a change in Simpson's personality or he had developed the capacity for stirring up intense enmity for D. McD. Lindsey wrote the Lighthouse Board protesting the appointment, saying that Simpson was a thief, a common drunk, and a notorious liar. He stated that Simpson had been a watchman at the War Department in Washington and while there had been arrested a number of times for drunkenness. Once he stole his roommate's pants and sold them to buy whiskey. Simpson undoubtedly was appointed, Linsey went on, because of the efforts of the principal keeper who was related to Simpson. The District Inspector was instructed to investigate the charges, but his findings have not survived. Whatever they were and whatever the action of the Board, Simpson was not dismissed, for three years later the Board received another letter, this time from an Alexander Hunter. Hunter charged Simpson with engaging in politics despite the rules and regulations against such activity, with being "indecently drunk" in uniform in Manteo, North Carolina, and "with being a felon, and thief, and man of vile habits, and unfit to serve the government of the United States." Hunter followed this letter up a few days later with one stating that Simpson had also been seen in the streets of

of Elizabeth City drunk.[100] Again the District Inspector was instructed to investigate and again the results of his investigation have not survived but the records of keepers show that Simpson continued on duty until 1899 when he was transferred to another station. One can't help but wonder that if the charges were true, what happened to change Simpson from such promising beginnings, and if the charges were untrue, what had the man done to attract such bitter and vituperative enemies.

With the increased professionalization of the Lighthouse Service there came a decrease in complaints against individual lighthouses. If the Lighthouse Board found a keeper negligent of his duties, the Board reprimanded or fired the keeper, depending upon the seriousness of the charge. The Board, however, usually did not dismiss keepers in the absence of thorough investigations. From time to time, however, they were not as thorough as they could be. In 1888, for example, when the principal keeper accused the 2nd assistant keeper of being asleep on duty the Board immediately

100. J. E. Walker to F. H. Baker, August 3, 1874, in Letter to Inspectors, 5th District, July 6, l874-June 27, 1877, Naval Secretary to 5th District Inspector, April 16, 1895, in Letters to Inspector, 5th District, July I, l894-June 30, 1895, D. McD. Lindsey to Naval Secretary, April 7, 1892, in Letters to Inspector, 5th District, January I, 1892-June 30, 1893.

ordered the dismissal of the assistant keeper. But when it appeared that the Board may have misunderstood the complaint, it ordered the Inspector to conduct a thorough investigation.

The increased professiona1ization did not eliminate entirely complaints about lighthouses, but certainly slowed them down to a mere trickle. In 1884 the Lighthouse Board received a complaint from the captain of the City of Savannah that on the night of May 25 the Cape Hatteras light ceased rotating. Six years later the captain of the steamship Picqua reported that Cape Hatteras light flashed every five seconds rather than ten seconds as the Light List stated. As it turned out this changed frequency of flash was due to "the wings of the governor [on the rotating mechanism] having been left open after oiling." The Lighthouse Board told the District Inspector to warn the keepers against the repetition of such an oversight. In 1895 the captain of the steamer Mexican reported the Cape Hatteras light stopped revolving for ten minutes. Four years later the light stopped rotating once again, this time apparently due to the worn rotating mechanism.[101] When compared with the complaints received

101. Lighthouse Board, Letters to 5th District Inspector, 1881-1885, p. 386; Naval Secretary to 5th District Inspector, June 4, 1884, in Letters to Inspector, 5th District, January 2, 1884-June 30, 1885; Naval Secretary to 5th District Inspector, May 31 and June 25, 1888, and January 30, 1889, in Letters to Inspector, 5th District, April 1, 1888-June 30, 1889; Naval Secretary to 5th District Inspector, October 28 and November 19, 1890, in Letters to Inspectors, 5th District,

when the lighthouses were under the jurisdiction of the Fifth Auditor of the Treasury, the complaints received after 1852 indicate that the Lighthouse Board, at least at Cape Hatteras, was running a pretty taut ship.

In the 1880's the Lighthouse Board decided to put its employees into uniform. The uniform consisted of a cap, coat, vest, and trousers, all made of dark indigo-blue jersey or flannel. The coat was double breasted with two rows of five yellow metal buttons, one now on each side. The cap had a yellow metal Lighthouse Service badge in the center above the visor. The uniform was manufactured by two Philadelphia firms: Wanamaker &Brown who had their firm at 6th and Market Streets, and Horstman &Brothers. The manufacturers were to ship the uniforms to the District Inspectors who were to distribute them to the individual keepers. There should have been no problem of fit, since the keepers had previously supplied their measurements to the manufacturers. The Lighthouse Board gave the first uniform free to the employees, but thereafter each employee

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July 2, 1889-December 29, 1890; Engineer Secretary to 5th District Inspector, September 17, 1895, in Letters to Inspectors, 5th District, July 1, 189S-December 31, 1896; Naval Secretary to 5th District Inspector, June 30, and September 13, 1899, September 6, 1900, in Letters to Inspectors, 5th District, July 1, 1900-December 31, 1900.

had to buy his own uniform,[102] which included fatigues as well as the dress uniform.

THE DIAMOND SHOALS LIGHTSHIP—THE SECOND ATTEMPT

During the years following the ill-fated attempt in the 1820's to station permanently a lightship on Diamond Shoals the lighthouse establishment experimented" with various techniques to warn the mariner of this dangerous area. The Fifth Auditor and

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102. Lighthouse Board, Letters to 5th District Inspector, 1881-1885, p. 377; Naval Secretary to 5th District Inspector, May 14, 1884, in Lighthouse Board, Letters to Inspectors, 5th District, January 2, 1884-June 30, 1885; A. B. Johnson, *The Modern Lighthouse Service* (Washington: 1890), p. 104. See Naval Secretary to 5th District Inspector, July 16, 1887, in Letters to Inspector, 5th District, January 1, 1887-March 31, 1888. Light stations were for light keepers. In 1908 Jacques Busbee requested permission to live at the station and paint scenes around there for the North Carolina Historical Society. The Lighthouse Board replied that it was against their policy “to grant permission to any other than the regular keepers to live at a lighthouse.” See Lighthouse Board, Letter Box, 1901-1910, Box No. 860, R.G. 26.

As a matter of interest, the following medicines were authorized by the Lighthouse Board for the medicine cabinet of the Cape Hatteras Light Station:

8 oz. Sweet spirits of nitre
8 oz. Arnica
8 oz. Essence of Jamaica Ginger quinine
8 oz. Cough mixture
12 oz. Rochelle salts
8 oz. Senna leaves
8 oz. Castor oil
4 oz. Carbolated oil and laudanum

later the Lighthouse Board tried various devices. For the most part efforts centered on the use of buoys, and whistling buoys.

Another variety of navigational aid was tried in 1852 when the Fifth Auditor authorized a bell boat for Diamond Shoals, but within four months it too vanished. As was the case with the bell boat the tempestuous nature of Diamond Shoals was simply too much for the buoys, and. generally, the seas ripped them from their moorings, and they disappeared. In one instance someone stole the whistle from the Diamond Shoals whistling buoy. This act so angered the Lighthouse Board that they authorized a reward of $500 for its return.[103] There is no evidence that it was recovered.

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2 oz. Glycerine
4 oz. Chloroform liniment
1 oz. Lactopeptin
3 oz. Saltpetre
2 oz. Sulphur zinc
100 Quinine pills
100 Compound cathartic pills
2 oz. Laudanum
2 oz. Calverts carbolic acid
1 oz. Iodoform
1 lb. Patent lint bandages
100 Opium and camphor pills
1 oz. Dover's powders
4 oz. Spirits camphor

See Naval Secretary to 5th District Inspector, July 16, 1887, in Letters to Inspector, 5th District, January 1, 1887-March 31, 1888.

103. Fifth Auditor's Office, Lighthouse Letters, March 1,1852-October 15, 1852, v. 31, p. 51; Naval Secretary to 5th District

The Lighthouse Board experimented diligently in the late 1870's and early 1880's with various types of buoys, but consistent failure marked their efforts. In the early 1880's a number of New York underwriters, merchants, and masters of vessels petitioned the United States Senate to have a lightship placed on Diamond Shoals. About the same time similar petitions were received from the New York Commissioners of Pilots and the New York Board of Underwriters. When notified of these petitions, the Lighthouse Board instructed the 5th District Inspector to investigate the feasibility of putting a lightship on the Shoals. At about this time thinking began to focus on a long dormant dream: build a lighthouse on Diamond Shoals. Although old, such an idea nevertheless, was pretty radical, and a long discussion ensued during which occurred a thorough airing of the pros and cons of the project. The Lighthouse Board quickly accepted the feasibility of the proposal, and as early as October 1883 tried to decide where on the Shoals to place the lighthouse. The Board instructed the 5th District Engineer to make test borings and a survey of the area to determine the best site. In the meantime, in 1884, the Lighthouse Board placed a gas buoy on

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Inspector, March 20 and May 7, 1884, in Letters to Inspectors, 5th District, January 1884-June 30, 1885; George R. Putnam, *Lighthouses and Lightships of the United States* (Boston: Houghton Mifflin, 1917),
pp. 93-94.

Diamond Shoals. Within a few months the riotous sea ripped the buoy from its mooring and the buoy drifted off. It was obvious, the Board concluded, "that such a buoy cannot be maintained at this point." Finally the Government decided to take the leap, and in 1889 Congress authorized the construction of a lighthouse on Outer Diamond Shoals, placing a $500,000 limitation on the cost of the structure.[104]

On March 2, 1889, Congress made an initial appropriation of $200,000 for the Diamond Shoals lighthouse. A contract was let for the structure, and the contractors began building in Norfolk a caisson fifty-four feet in diameter and forty-five feet high. In 1891 they towed the caisson out to Diamond Shoals and on July 1 lowered it in twenty-two to twenty-five feet of water. Water swirling • around the base of the caisson soon eroded the foundation and tilted the caisson out of level. The final blow came on July 8 when a storm swept the area and destroyed the construction machinery and the top of the caisson. The contractors threw up their hands and suspended work, thus ending the first real effort to build a lighthouse on Diamond Shoals.

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104. Naval Secretary to 5th District Inspector, January 6, l883, in Letters to Inspectors, 5th District, July 5, l882-December229, l883, Naval Secretary to 5th District Engineer, in Letters to Engineer, 5th District July 1, l883-June 30, 1885, Lighthouse Board, Letters to 5th

The Lighthouse Board made another attempt three years later and floated an iron frame out to the shoals where test borings to 105 feet were made. The Board then proposed erecting a skeleton iron lighthouse that would be supported on heavy iron piles. But this project, too, died aborning, and in 1896 Congress lowered its vision and appropriated money for a lightship for Diamond Shoals. Lightship No. 69 was constructed and placed on station on September 30, 1897.[105]

The idea of a lighthouse on Diamond Shoals did not fade away at this point as one would suspect. In 1902 the Lighthouse Board had concluded that: "while it is considered to be practicable to build a light-house on Diamond Shoal, it is not advisable to do so; that a lightship would be as useful navigation, and that with the improved means of mooring a lightship, she can be depended on with reasonable certainty to be on her station at all times."

Congress did not agree with the position of the Lighthouse Board, and in 1904 authorized the erection of a lighthouse on Diamond Shoals. The act provided that Albert F. Eells of Boston would construct the lighthouse and operate it for a year. He would then turn it over to

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District Inspector, 1881-1885, pp. 269, 300, 331, 347, 379, 383, 475; Putnam, *Lighthouses and Lightships,* p. 94.

105. Putnam, *Lighthouses and Lightships,* pp. 94-95; Lighthouse Board, *Annual Report, l889,* p. 93; *Annual Report, l892,* p. 96; *Annual Report, l897,* p. 103.

the Lighthouse Board who would operate it for four years, and if satisfied with the structure, the Government would then pay Eells and those associated with him $590,000. A year later Congress upped this sum to $750,000, if certain conditions were met. Eells and his associates failed to follow through with the project, and in time the act lapsed.[106]

Congress continued for a number of years to hold hearings on the feasibility of erecting a lighthouse on Diamond Shoals, but nothing tangible resulted, and the lightship remained on station off Cape Hatteras, warning the mariner of these dangerous shoals. "Diamond Shoal Lightship," the Commissioner of Lighthouses said, "occupies one of the most exposed stations for such a vessel in the world." Storms buffeted the ship and in at least one instance, in 1899, drove the light vessel onto the beach near Cape Hatteras. On occasion she suffered collisions with sea-going ships, and on August 6, 1918, a German submarine sank her with gunfire.[107] But through

106. Putnam, *Lighthouses and Lightships,* p. 95; Naval Secretary to 5th District Engineer, December 10, 1902, in Letters to Engineer, 5th District, July 1, 1902-December 31, 1903, Engineer Secretary to 5th District Engineer, July 13, 1904, in Letters to Engineer, 5th District, January 1, 1904-June 30, 1905; Lighthouse Board, *Annual Report, 1905* (Washington: G.P.C., 1905), p. 7.

107. Putnam, *Lighthouses and Lightships* (1933 edition), pp. 96-97, 307. In addition to her two lights, the Diamond Shoals Lightship from 1908 to 1911 also had a huge search light. The vessel displayed

the years the Lighthouse Service continued to maintain a light vessel on Diamond Shoals. Finally in the 1960's technology progressed to the point that man could successfully erect a lighthouse on the turbulent Diamond Shoals, and on January l, 1967, a Texas tower-type structure replaced the lightship.

CAPE HATTERAS LIGHT STATION—1900-1968

The problem of the stagnant water around the light station reared its head again in the early years of this century. In 1901 the keeper of the Cape Hatteras Life Saving Station reported that the standing water caused much sickness—both malaria and rheumatism—which resulted in the regular life savers being off duty much of the time because of illness, thus necessitating the use of undrilled men. As a solution he recommended digging a drainage ditch between the station and the back landing. On learning of the problem of the ponds the Life Saving Service notified the Lighthouse Board, since it was a mutual problem—the ponds were not confined to the boundaries of either station alone. An investigation by the Lighthouse Service revealed that the ponds were a small part of a general

this light, which moved from horizon to zenith, only on dark nights, not usually on moonlight nights. See Lighthouse Board, *Light List, 1908* (Washington: G.P.O., 1908) pp. 176-177 and *Light List, 1911,* pp. 114-115.

marshy area where the malaria mosquito bred freely. The District Inspector said the condition imperiled the health of the keepers and their families. Both he and the District Engineer recommended cutting a ditch from the marsh to the back landing creek and opening the closed places in the creek so that the movement of the tide would flush out the marshy area. The Lighthouse Board accepted the recommendation of the joint report and agreed that the work should be done and that the Board should cooperate with the Life Saving Service in doing the work. The Board instructed the Inspector to submit a cost estimate and plan of work.[108] Presumably the work was done since there is no mention thereafter of the problem.

From time to time trouble arose with the rotating mechanism of the light, and the Cape Hatteras light was such an important and prominent one that few mishaps went unnoticed or unreported. For example, on the night of December 5-6, 1907, the light flashed irregularly, a fact noted and reported by the Urania. Upon investigation the Board learned the culprit had been rotating the mechanism which was in poor condition—a condition, incidentally, that perhaps should not have existed at that time since the Board four months

108. P. H. Etheridge to S. I. Kimball, Cape Hatteras, May 11, 1901; W. A. Jones to Lighthouse Board, Baltimore, September 21, 1901; A. Ross and W. A. Jones to Lighthouse Board, Baltimore, October 2, 1901; and W. Maynard to A. Ross, Washington, October 15, 1901; all in File No. 860.

previously having heard the mechanism was not working properly had instructed the District Engineer to have it repaired.[109]

At least one attempt was made to lay the blame for a shipwreck upon the Cape Hatteras light by accusing it of malfunctioning. On the night of November 28, 1909, the Brewster, a German steamship went aground. The ship struck at 6:30 p.m. on the "N.E. point of inner Diamond Shoale [sic] about six miles from the [Cape Hatteras] Light…." The principal keeper of the Cape Hatteras light reported that he talked to the skipper of the Brewster who told him "he mistook the Tower Light for the Lt. ship [.] [H]e said he made the light when it was first lit but never saw the Lt. ship [.] [H]e went down to supper and when he went on the bridge again the mate called his attention to breakers and he told him it was tide rip and in a few minutes the ship fetched up and then he found out where he was[.]" The Brewster did not go down immediately, and the crew abandoned ship, the mate and four seamen making it to the lightship by 10:30 p.m. where they remained for three days before being taken off.

In Hamburg a hearing began into the cause of the accident. The weather could not be blamed since the accident occurred on a night that was clear and calm with a slight breeze blowing and a full moon

109. Lighthouse Board, Letter Box, 1901-1910, File No. 860; Engineer Secretary to 5th District Engineer, August 12, 1907, in Letters to Engineer, 5th District, July 1, 1907-July 31, 1909.

shining. The skipper testified he mistook the Cape Hatteras light for the Diamond Shoals light vessel, which indicates he was at least being consistent in his story. The ship's insurance company sent an investigator to Cape Hatteras to find evidence to support the captain. Captain H. B. Saunders, the investigator, reported that he had found that the interval of darkness between flashes of the Cape Hatteras light was five and six seconds, not ten seconds as stated in the Light List. When confronted with this finding, the Lighthouse Board explained that the interval of darkness is measured from the beginning of one flash to the beginning of the next, and anyway, the Board added somewhat huffily, how could the lighthouse be mistaken for the light vessel when the light vessel has two lights, one at each masthead. Despite the Board's explanation, nevertheless, the Underwriters felt that the loss of the Brewster was due to a poor light at Cape Hatteras, a view, however, not held by all involved.

Hagedorn and Company,[110] New York insurance brokers, who represented the European Underwriters, wrote: "With all due respect to the captain of the 'BREWSTER' and to Mr. Saunders, we are obliged to regard their statements with a certain degree of doubt, as we cannot believe that any American lighthouse or light ship displays lights otherwise than exactly as they are described in the various guides to navigation."

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110. Hagedorn & Co. to Secretary of Commerce & Labor, New York, January 19, 1910; James Bryce to P. C. Knox, Washington, February 5, 1910; W. B. Caperton to Messrs. Hagedorn & Co., [Washington],

At this point the matter was dropped, but the Lighthouse Board had some doubt and asked the Inspector and the Engineer of the Fifth District their opinion as to the necessity of changing the characteristics of the lighthouse or the light ship. Both the Inspector and the Engineer replied that they felt no change was necessary, but if the Board did decide on a change, the light vessel was the one that should have its characteristics altered. The Light Lists for the period indicate that between 1908 and 1911 the characteristic of the light vessel was changed from a twelve second flash and three second eclipse to a twenty-five second flash and five second eclipse which may or may not be significant. Light Lists for 1909 and 1910 could not be located. In 1904 the U. S. Navy requested permission to erect a wireless station on the grounds of the light station. After a study by the Engineer and the Inspector of the District the Lighthouse Board gave its permission.[111]

February 3, 1910, F. E. Simpson to 5th District Inspector, Cape Hatteras Light Station, February 19, 1910, C. N. Fulcher to Lighthouse Inspector, Cape Hatteras Light Station, February 19, 1910, Thomas Jacobson to L. R. de Steigner, Light Vessel No. 71, February 28, 28, 1910; 5th District Engineer & 5th District Inspector, to Lighthouse Board, Baltimore, March 1, 1910, Thomas Jacobson to L.R. de Steigner, Baltimore, March 5, 1910; and Asst. Secretary of State to Secretary of Commerce & Labor, [Washington], March 17,1910; all in File No. 860.

111. Engineer Secretary to 5th District Engineer, December 17, 1904, in Letters to Engineer, 5th District, January 1, 1904-June 30,

Erosion once again threatened the site of the light tower at Cape Hatteras. In 1919 the shore line had eaten to within 300 feet of the tower and was inching closer. For five years, beginning in 1924, the Commissioner of Lighthouses asked for funds to control the erosion, but Congress was not responsive. In 1930 repairs, as a result of damage by a hurricane, permitted the Lighthouse Service to install 900 linear feet of "interlocking sheetpile groins" along the beach "to protect this station from further erosion by the sea." This effort did not prove adequate and within a few years only 100 feet separated the tower and surf. In 1933 the Lighthouse Service installed more steel sheet pile groins. But by now the Service had decided that erosion by the sea could not be halted, and began the process of acquiring land for a new site for the light. The keeper of the Cape Hatteras light, U. B. Jennette, owned the land the Service desired, and negotiations between the two parties began. Jennette agreed to sell the land for $266,880 and turned the land over to the Lighthouse Service in 1935. There were, however, certain defects in the title and because of the "emergency affecting this site," both parties agreed to go through condemnation proceedings. The case was carried to court and in 1936 the Lighthouse Service officially acquired

1905; Lawrence O. Murray to Secretary of the Navy, Washington, February 3, 1905, in Site File, Cape Hatteras Light Station.

the land. In the meantime the Service began erecting on this land a skeleton tower 150 feet tall and a power house. The tower was completed September 18, 1935, and painted black. The Lighthouse Service placed the light on the tower, and it was exhibited on May 13, 1936. The forty-four acres comprising the old light station was turned over to the Department of the Interior for use by the National Park Service.[112]

In time threat of erosion eased, and the Coast Guard felt that the brick Cape Hatteras tower was the better place from which to display the light. Accordingly, that organization made arrangements with the National Park Service in 1950 to move the light back to the tower, and today visitors to the Cape Hatteras National Seashore can climb the spiral metal stairways to the lantern and go out on the gallery, but they are not permitted to enter the upper part of the lantern where the lens is.

112. Commissioner of Lighthouses, *Annual Report, 1924* (Washington: G.P.O., 1924), p. 40; *Annual Report , 1930* (Washington: G.P.O., 1930), p. 28; *Annual Report, 1933* (n.t.p.), p. 103; *Annual Report, 1934* (n.t.p.), p. 111; *Annual Report, 1935* (n.t.p.), p. 123; Lighthouse Service, *Light List, South Atlantic Coast, 1937* (Washington: G.P.O., 1937), pp. 22-23. Acting Attorney General to secretary of Commerce, Washington, June 1, 1935; Superintendent of Lighthouses, Norfolk, June 4, 1935; Attorney General to Secretary of Commerce, Washington, June 4, 1935; C. J. Peoples to Secretary of the Interior, [Washington], August 31, 1936; Transcript of Condemnation Proceedings, U. S. District Court of Eastern North Carolina, Case No. 273-LAW; E. J. Byrum to U. B. Jennette, receipt, November 9, 1936; Newspaper Clipping, c 1932, all in Site File, Cape Hatteras Light Station, R.G. 26, National Archives.

APPENDIX A

THE CAPE HATTERAS LIGHT TO THE SEAMAN

The Cape Hatteras tower served not only as a support for the light, but in time also as a daymark. Its importance and use as a daymark, however, did not come about for many years. During its first fifty years the administrators of the country's aids to navigation failed to recognize, indeed ignored, the tower's value as a daymark. For years the tower remained its natural color, and the *Light Lists* for 1838, 1848, and 1849 (the only ones this writer could locate that were issued by the Fifth Auditor of the Treasury) made no mention of the tower or its color. The only concern was with the light. The first description of the tower that appeared in a *Light List* occurred in the 1852 edition, the first *Light List* issued by the newly constituted Lighthouse Board. The *Light List* described the tower as being brown. Within two years, however, the Lighthouse Board painted the tower to make it more distinctive, and the 1854 *Light List* described the tower as being grey to twenty feet above the base; the remainder was red. By 1859 the Lighthouse Board had increased the height of the tower, thus necessitating repainting the structure. The *Light List* for 1859 showed the tower as being painted white for its first seventy feet

and red for the remainder.[1] And it continued thus until the new tower was finished. After a brief period of being covered with a brick-colored wash, the Board had the new tower painted its distinctive black, and white spiral bands in 1873.

The characteristic of the light in the tower changed several times over the years. It, however, remained a white light. When first lighted, the tower's lantern contained lamps. Later, Winslow Lewis introduced his system of lamps and reflectors into the lantern. The tower exhibited a fixed white light, visible, according to the Fifth Auditor of the Treasury, 18 miles. By 1848 the number of lamps and reflectors had been reduced to fifteen, but the size of the reflectors increased to twenty-one inches. The light characteristic of the light remained fixed, white, but Pleasonton announced that the distance the light was visible had increased to 20 miles. Since the curvature of the earth governs the distance a light can be seen, and since the height of the tower had not been increased, it is difficult to figure Pleasonton's reasoning for the increased visibility.

In 1854 the Lighthouse Board had the tower raised, moving the light up to 150 feet above sea level. The *Light List* now showed the

1. Stephen Pleasonton, *The Lighthouses, Beacons, and Floating Lights of the United States for l838* (Washington: Blair & Rives,

light as being visible 19 nautical miles. At that time a first order revolving lens was placed in the 1anternR changing the light's characteristic. In every minute it flashed three times for eight seconds and eclipsed three times for twelve seconds. In 1856 the light characteristic was changed to four six-second flashes and four nine-second eclipses every minute.

After the Civil War the *Light List* showed the Cape Hatteras tower as having a five-second flash and a fifteen-second eclipse. In 1868 the light was again changed, this time to six flashes and eclipses every minute.[2]

In 1913 the Lighthouse Service changed the illuminant to an incandescent oil vapor lamp, and. the following year they altered the characteristic to flashing 1.4 seconds in every six seconds. At the same time the candle power was reduced from 160,000 to 80,000. Twenty years later, in 1934, the Service electrified the Cape Hatteras

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1838), pp. 8-9; Stephen Pleasonton, *List of Lighthouses, Beacons, and Floating Lights of the United States, 1848* (Washington: C. Alexander, 1848), pp. 22-23; U. S. Lighthouse Board, *Light List, 1852* (Washington: Gideon & Co., 1852); U. S. Lighthouse Board, *Light List, 1854* (Washington: A.O.P. Nicholson, 1854), pp.330-31; U. S. Lighthouse Board, *Light List, 1859* (Washington: WID. A. Harris, 1859), pp. 46-47.

2. Stephen Pleasonton, *The Lighthouses, Beacons, and Floating Lights of the United States for 1838,* pp. 8-9; Pleasonton, *Light List, 1848* pp. 22-23; Lighthouse Board, *Light List, 1854,* pp. 30-31;

tower, and the candle power increased to 450,000. When the light was moved to the skeleton tower three years later the characteristic of the light was changed to one second flash every ten seconds, and the candle power reduced to 80,000. In 1950 when the light was moved to its old residence in the tower the characteristic was changed to three seconds flash every 15 seconds and the brightness increased to 250,000 candle power.[3] It has retained that characteristic to the present day.

U. S. Lighthouse Board, *Light List, l856* (Washington: A.O.P. Nicholson, 1856), pp. 34-35; U. S. Lighthouse Board, *Light List, l866* (Washington: G.P.O., 1866), pp. 46-47; U. S. Lighthouse Board, *Light List, l868* (Washington: G.P.O., 1868), pp. 28-29.

3. Commissioner of, Lighthouses, *Annual Report, 1913* (Washington: G.P.O., 1913), p. 45; Lighthouse Service, *Light List, Atlantic and Gulf Coasts, 19l4* (Washington: G.P.O., 1914), pp. 150-151; Lighthouse Service, *Light List, Atlantic Coast, 1934* (Washington: G.P.O., 1934), pp. 212-213; Lighthouse Service, *Light List, South Atlantic* Coast, *1937* (Washington: G.P.O., 1941), pp. 22-23; U. S. Coast Guard, *Light List, Atlantic Coast, Southern Part, 1941* (Washington: G.P.O., 1941), pp. 22-23; U. S. Coast Guard, *Light List, Atlantic Coast, Southern Part, 1941* (Washington: G.P.O., 1950), pp. 382-383.

APPENDIX B

PROPOSAL TO BUILD FIRST CAPE HATTERAS AND SHELL CASTLE LIGHTHOUSES

Proposals for building a Light-House &c. on the Head Land of Cape Hatteras, on the Coast of North Carolina, of the following Materials, Dimensions and Descriptions:

The Form is to be occtagonal; [sic] the Foundation is to be of Stone, to be sunk thirteen Feet below the Bottom of the Water Table, or Surface of the Earth; and to be commenced of the Diameter of twenty-nine Feet from such Commencement to the Height of four Feet.—The Foundation is to be laid solidly; and from thence to the Bottom of the Water-Table, the Foundation Wall is to be nine Feet thick, and nine reet thick, and nine Feet high. The Diameter of the Base from the Bottom of the Water Table to the Top thereof (when the occtagonal [sic] Pyramid is to commence) is to be twenty-eight feet--four Inches, and the wall is to be seven Feet thick. The Wall of the octagonal Pyramid is to be six Feet thick at the Base thereof, or the Top of the Water Table. The Height of the Building from the Bottom of the Water Table &c. from the Surface of the Earth is to be ninety Feet to the Top of the. Stone Work under the Floor of the Lantern where the Diameter is to be sixteen Feet and an half; and the Wall three Feet.—the <u>whole</u> of the Wall to be built of Stone.

The Water-Table is to be cap'd with sawed Stone, at least eight Inches Wide, sloped to turn off the Water. The outside of the Walls are to be faced with hewn or hammer-dressed Stone, having four windows in the NorthEast, and five Windows in the SouthWest.—the Sashes to be hung with Hinges; and each Sash to have twelve Panes of Glass, 8 by 10 Inches.

On the Top of the Stone Work is to be a framed tier of Joists, bedded therein, planked over with Oak plank, extending one Foot and one half beyond the Wall, thereby forming an Eave which is to be finished with a Cornice, the whole having a Descent from the Center, sufficient to throw off the Water, and to be cover'd with Copper. A complete and sufficient Iron Lantern in the octagonal Form is to rest thereon with a complete Sett of Lamps; constructed according to the Plan and Directions in the annex'd Draft.

The eight Corner Pieces or Stauncheons of the Lantern are to be built into the Wall to the Depth of eight Feet, where they are to be secured by eight large Iron anchors passing through the Wall, the Ends of which are to be secur'd into an Iron Band on the outside, which will be in contact with the Conductors. These staucheons to be 3 inches by 2½ inches in Diameter—the Lantern to be six feet, six inches in the smallest Diameter; it is also to be eight feet six inches high from the Bottom of the Floor to the Dome or Roof,

and to have a Dome or Roof four feet in Height. The whole Space between the posts J or upright Pieces at the angles is to be occupied by the Sashes, which are to be Struck solid.—The Sashes to be constructed for receiving Panes of Glass 14 by 12 Inches. A Part of the Sash on the Southwest &c. is to be hung on Hinges for a convenient Door to go out on the Platform. The Rafters of the Lantern are to be framed into an Iron Hoop over which is to be a Copper funnel, through which the smoke may pass into a large copper ventilator in the Form of a Man's Head, capable of containing sixty Gallons. This Head is to be turned by a large Vane, so that the Hole for venting the smoke may be always to Leeward. Eight dormant ventilators are to be fix'd in the Roof, a large curv'd Air Pipe is to pass through the Floor and a Close Stone is to be provided and fix'd in the Lantern.—there is a strong Railing to form a convenient Balcony around the Lantern and eight Pairs of Stairs to ascend thereto. The Entrance to the Lantern is to be by a Trap Door covered with Copper. The Building is to be Furnish'd with two complete Electrical Conductors, or Rods with Points. The Floor to be laid with Plank of at least one & an half inch in Thickness. The Entrance to the Light House is to be well secur'd by a strong Door hung upon Hinges, with a Strong Lock ~d Latch complete.--

An Oil Vault is to be built 20 Feet by 12 in the Clear, and arch'd over and cover'd with Earth or Sand; over which a shed is to be built—it is to be furnished with nine strong Cedar Cisterns, with strong Covers, each capable of containing One hundred Gallons of oil—These Cisterns are to be sunk in Clay, which is to be well rammed round them—The Space above the Cisterns to be Sufficient to accommodate an equal quantity of Surplus oil—the Entrance to the Vault to the well secur'd by a Strong Door with Latch and Lock.

Also a Frame House, to be 34 Feet in front, and sixteen Feet deep, with a Cellar under it; the Cellar Walls to be 18 Inches thick and 7 Feet high. The first Story of the House to be 8 feet, the second 7 Feet high. The Floor to be laid whole Lengths and nailed through. The Stack of Chimnies is to be finished with two plain Fire Places on each Floor, one of them large for a kitchen, two Windows below and three above in front and rear; each Sash to have 18 Panes of glass, 10 by 12 Inches; the Doors to be hung and finished completely. The Ceilings and Sides of the House to be plaister'd with two Coats; all the wood work inside &out to be painted well, and the whole finished in a plain decent Manner. A Well is to be Sunk at a convenient Distance, and furnished with a Curb, Bucket and Rope complete.

If it should be impracticable on account of a Flow of water, or any other insuperable Cause to sink the Foundation of the Light

House to the Depth of thirteen Feet, or, if the soil at the Depth from the Surface be deemed too unstable to support the Weight of the proposed Building, the Foundation is to be underlaid and perfectly Secur'd by Timbers of large dimensions.

Proposals for building a Beacon House on Shell-Castle Island, in Pamptico Sound, near Occacoke Inlet, in North Carolina, of the following materials, Dimensions and Descriptions.—viz.—The form is to be Octagon. The Foundation, Stone, to be sunk 5 Feet below the surface of the Earth, and to be commenc'd of 23 Feet Diameter. It is to be laid Solidly to the Height of two Feet, from thence to the Height of 6 Inches above the Earth, or to the Bottom of the wooden work, the Foundation is to be 3½ Feet high and 4½ Feet thick.

The Octagonal Pyramid is to be well framed, and of Stout Heart
Pine Timber. It is to be 22 Feet in Diameter at the Base thereof, where it will rest on the Top of the Stone Foundation, to which it is to be well secur'd by 16 Stout Iron straps built therein and otherwise fasten'd.

The Height of the Wooden Building from the Top of the Stone Work (Six Inches above the surface of the Earth) is to be 54½ Feet to the Top of the Wooden Work under the Floor of the Lantern, where the Diameter is to be 12 feet. The Foundation is to be cap'd with Sawed Stone, at least 8 Inches wide, and sloped to turn off the Water.

The Frame of the Pyramid is to be cover'd with Boards of one Inch and one half in Thickness, over which is to be laid a good and complete Covering of Shingles, and it is to be well painted with three Coats. It is to have two Windows in the east, and three in the West, the Sashes to be hung with Hinges, and each Sash is to have eight Panes of Glass 8 by 10 Inches.

On the Top of the wooden work of the Pyramid is to be a strong fram'd Tier of Joists, bedded therein, planked over with Oak Planks extending one Foot beyond the sides of the Pyramid, thereby forming an Eave, which is to be finished by a Cornice, the whole having a Descent from the Center sufficient to throw the Water off, and to be covered with Copper.

A complete &Sufficient Iron Lantern, on the Octagonal Form, is to rest thereon, with a complete Lamp, constructed according to the Plan and Dimensions in the annex'd Draft. The eight Corner Pieces or Stauncheons, of which are to be well secur'd to the upright Timbers of the Pyramid, or to both the Joists and upright Timbers of the Pyramid. These Stauncheons to be 2½ inches in Thickness in the lower eight Feet, and two inches thick above the Floor of the Lantern. The Lantern to be 4 Feet 6 Inches in the smallest Diameter, 6 Feet high to the Bottom of the Dome, and to have a Dome or Roof 3 feet high. The whole Space between the posts or upright Pieces at

the angles to be occupied by Sashes which are to be Struck solid, the Sashes constructed so as to receive Panes of Glass of regular Sizes not less than 10 by 12 nor more than 14 by 12 Inches. A Part of the Sash on the Southwest side is to be hung with Hinges for a Door to go out on the platform. The Rafters of the Lantern to be framed, into an .Iron Hoop, over which is to be a Copper Ventilator, in the Form of a man's Head, capable of containing 30 Gallons. This Head is to be turn'd by a large Vane, so that the Hole for venting the smoke may be always to Leeward.

Eight dormant Ventilators are to be fixed on the Roof—a large Curved air Pipe is to be pass'd through the Floor. There is to be a strong Iron Railing to form a convenient Balcony around the Lantern. There are to be five Pairs of Stairs to ascend to the Lantern, the Entrance to which is to be a Trap Door cover'd with copper.

The Building is to be furnished with two complete electrical Conductors, or Rods with Points. The Floor to be laid with Planks. The Entrance to the Light House is to be well secur'd by a Strong Door hung upon Hinges with a Strong Lock and Latch complete. Also a Frame Dwelling House of One Story to be twenty eight Feet in front and fifteen Feet deep, with a Cellar under it, if it should be found practicable to make one. The Ce11er Walls to be fourteen Inches thick and seven feet High. The Story of the House to be seven

and an half Feet in the clear, the Roof to have a Rectangular pitch, the Floor to be laid in whole Lengths, nail'd through. The House to be composed of 2 Rooms, of about 13 1/2 by 14½ Feet in the lower Floor. The stack of Chimnies to be between the two sitting Rooms; to have two Fire Places, one of them large for a Kitchen, to which is to be join'd an Oven. There is to be an Outward Door in front and one between the two Rooms in the Rear in the Kitchen-two windows in each Room-each Sash to contain 12 Panes of Glass, 10 by 8 Inches-each window to have strong plain Shuttles, fastning [sic] and Hinges-the Doors to have complete fastning [sic]? hung and finished; the Ceiling and inside to be plaster'd with two Coats; all the wood outside to be well painted and the whole finished in a plain, decent Manner.

An Oil Vault is to be built 10 by 12 Feet in the clear, arch'd over and cover'd with Earth or Sand, over which is to be built a Shed-it is to be furnished with three strong Cedar Cisterns, with Covers-each capable of containing two hundred Gallons. The Entrance to the Vault is to be by a strong Door which is to be well secur'd.

The Subscriber will find all the Materials, labor and other objects of Cost and Expense and will execute the before described Work. (Viz.-the Erection of a Light House &ca on the Head-Land of Cape Hatteras, & a Beacon &ca on Shell-Castle Island,) in a good and

Workmanlike manner, for the Sum of Thirty eight thousand Four hundred & fifty Dollars, to be paid in the following manner:

Eight thousand Dollars at the first, to provide the materials &ca.

Six thousand Dollars when the first Story Beams of the Light House are laid.

Eight thousand Dollars when the Lantern of the same is finished.

Three thousand Dollars when the Foundation of the Beacon is laid.

Three thousand Dollars when the Lantern is finished, and the Remainder, when the whole Work is finished and complete-and he further engages that the providing materials and Commencement of the Work shall be immediately begun, and the whole work finish'd with all possible Speed.--

Henry Dearborn

Pittstown August 21, 1798
Approved September 21, 1798

Signed: John Adams

William Miller Jr. CK

(The contract on file in the comptroller's office)

From "Lighthouse Deed and Contracts," R.G. 26, National Archives

APPENDIX C

FIRST DESCRIPTION OF CAPE HATTERAS AND SHELL CASTLE LIGHTS[1]

We the ·undersigned have examined the Light House at Cape Hatteras with the buildings thereto appertaining and the lantern of the Beacon at Shell Castle Island.

We find the Light House continued from the height reported by Mr. Tredwell to that of Ninety feet carried up conformable to contract with great exactnefs and the work well executed. The joists on the top of the stone work are planked over with cypress instead of oak planks (but we consider the former to be fully as durable as the latter) projecting as contemplated and finished by a neat cornice. We find the lantern finished and of the size mentioned in the contract with all the ventilators and vane complete. The diameter of the lantern tho' conformable to contract however only admits of Glass of the 10 by 12 size instead of 12 by 14 as was contemplated the iron work and copper are complete and well executed excepting the floor of the lantern and a small part of the deck which is not yet covered. The building is furnished with two complete Electrical conductors with points. It appears that the size of the lantern would not admit of the stauncheons being built

1. This letter is in R.G. 26, National Archives.

into the Wall, and as that could not be done the contractor has placed eight upright pieces of strong scantling secured to the joists on the top of the stone work and to those of the story next below which the iron staucheons are bolted at foot which with the outer braces we are of opinion render the lantern perfectly secure. The lamp is placed in the lantern, there is however no air pipe fixed to pass thro' the floor nor is there a close stove provided and fixed in the lantern. There is a strong railing which forms a convenient Balcony around the lantern and -eight-pair upstairs to ascend thereto-the floors are laid with planks of the contemplated thickness. There are wires passing thro' the outer braces and railings to keep off Flocks of Fowl in the night. The oil vault having been reported upon before it remains for us only to speak of the cisterns which are five in number and are supposed to contain four hundred and fifty or five hundred gallons. The cisterns are well rammed around with clay and have the appearance of being tight-they have all covers. The keepers House is of the dimensions and is finished agreeably to contract the cellar is however not under the whole of the House, but we suppose it sufficiently large for any purposes of the keeper- there is yet something to be done about the Cellar Door which Mr. Hobart mentioned to us he had given directions about he has also give directions for coppering the floor of the

lantern as soon as the materials arrive from Philadelphia. We found the lantern of the Beacon erected and of the Dimensions conformable to contract with the lamp within it, the size of the lantern however not corresponding with the top of the building the stauncheons could not be secured to the upright timbers of the Pyramid but are fixed in the manner with those of the Light House at the Cape. The upper joists are planked over with cypress plank which extends agreeably to contract thereby forming an eave which is finished by a neat cornice- all the iron work of the lantern excepting the sheet iron around the lower part of it which remains yet to be revited is finished and well executed. The copper work of every description with all the ventilators and vanes are finished with two Electrical conductors with points. There is a strong iron rai11ng which forms a convenient balcony around the lantern there is wire provided which is to be fixed as to form the same security against fowl in the night. With that at the Cape there is no air pipe as yet provided and fixed in the floor of the lantern.

The glass of the lantern yet remains to be put in which Mr. Hobart has made arrangements for being done as well as reviting the sheet iron around the lower part of the lantern. The Beacon and keeper's House having been already examined and reported by

Mr. Taylor, we suppose it unnecessary to repeat anything on that subject here.

Edenton, September 4, 1802

James Hathaway, Sr.
Samuel Tredwell

APPENDIX D

DESCRIPTION OF CAPE HATTERAS LIGHT STATION
IN 1858

Cape Hatteras Light Station
Name: Cape Hatteras
Number of Lights: One
Location: North of extremity of the Point of the Cape about 2 miles.

Tower
Color: White and Red
Materials: Stone and Brick
Height from base to coping: 118 feet
Thickness of Walls at base: 5½ feet
Size of each pane: 10 x 12 & 8 x 10
Staircase materials: Wood
Number of air tight oil butts: (six old pattern, not air tight)
Thickness of Walls at top: 2½ feet
Interior Diameter at base: 15 feet
Interior Diameter at top: 12 feet
Number of windows: 11

Keepers' House and Grounds
Number of Houses: One dwelling &one smoke house
Color: White
Materials: Wood

Roof-material: Shingle
Color: Has been red, all washed off
Horizontal Dimensions: 48 x 20
Number of stories: 2
Number of rooms: 6
Use of rooms: Keepers & families

Lantern
Painted or otherwise: Whitewashed and painted
Wells: One
House fixtures: Pendulum clock
Grounds, area of: 47 acres
Cultivated or not: Not, mostly covered with water
Number of boats: 9

Illuminating Apparatus
Order: 1st
Kind: Lens
Arc Illuminated: 360°
Color of Light: White
Characteristic: Flashing
Duration of flash: 6 seconds
Height above sea level: 165 feet

Lantern
Materials: Iron

Interior Diameter: 12 feet
Height glazed: 9 or 10 feet
Number of sides in plan: Circular
Number of panes in side: 96
Size of panes: 37 x 27 irregular
Floor material: Iron
Arrangement for closing glass inside and out: Good

Lamps
Kind: Mechanical
Number: 3

Cape Hatteras Beacon
Color: White
Number of Windows: One
Number of panes in each: 12
Staircase Materials: Wood
Watch room: Under lantern
Warming: Stove
Number of air tight oil butts: 1 of 50 gallons

Illuminating Apparatus
Order: 6th
Kind: Lens
Arc Illuminated: 315°
Color of Light: White

Characteristic: Fixed
Height above sea level:30 feet

Lamp
Kind: Fountain

Lantern
Materials: Iron
Interior Diameter: 3 7/12 feet
Height glazed: 32 inches
Number of sides in plans: 6
Number of panes in side: 6, 2 of copper
Size of pane: 30 x 32 inches

DESCRIPTION OF BEACON
"Wooden framework supporting a lantern. The tower part enclosed for a watchroom and storeroom. Placed near the pitch of the Cape about 1½ miles from the principal light."

"A cistern badly wanted at this station—after a gale most of the ground is covered with salt water. The Beacon leaks badly. Should be attended to in spring."

From "Descriptive List of Lighthouses, 5th District, 1858" V. 2, R.G. 26, National Archives.

APPENDIX E

A PARTIAL LIST OF KEEPERS AND ASSISTANT KEEPERS OF THE CAPE HATTERAS LIGHT

KEEPERS

Name	Annual Salary	Date of Appointment	Date of Vacation	Manner Vacated
Adam Gaskin		1802		
Joseph Farrow		1808		
Pharoah Farrow		April 1821		
Isaac Farrow		1830		
Joseph C. Jennett		1842		
Benjamin Fulcher				
Hezekiah F. Famett (interim keeper, 1849)				
William O'Neal	$600	July 7, 1853	July 9, 1860	Resigned
E. F. O'Neal	600	June 9, 1860	October 16, 1860	Removed
B. F. Fulcher	600	October 15, 1860		
Abraham C. Farrow	600	September 30, 1862	April 14, 18643	Removed
George W. Rodgers	600	April 14, 1864	August 16, 1866	Resigned
A1pheus W. Simpson	820	August 16, 1866	September 30, 1868	Resigned
Benjamin C. Jennett	820	September 30, 1868	March 15, 1871	Removed
John W. Shepperd	820	March 15, 1871		
Oscar F. Rue	800	April 24, 1878		
J. Wilson Gillikin	800	December 6, 1897	June 1, 1900	Transferred
Ephraim Meekins, Jr.	800	June 1, 1900	October 1, 1906	Transferred
Fabius E. Simpson	800	October 1, 1906		
Unaka B. Jennette	800			

ASSISTANT KEEPERS

Name	Annual Salary	Date of Appointment	Date of Vacation	Manner Vacated
H.B. O'Neal	$300	April 7, 1854		
W.B. O'Neal	300	April 7, 1854		
R. Scarborough	300	January 23, 1855		
E.D. Neal	300	October 30, 1856	October 18, 1860	Removed
C. Fulcher	300	January 1, 1858		Deceased
William Jennett	300	June 9, 1860	October 16, 1860	Removed
Andrew Williams	300	October 15, 1860		Removed
B.A. Williams	300	October 15, 1860	September 7, 1865	Removed
Wallace R. Jennett	300	July 18, 1863	September 7, 1865	Removed
N. T. Williams	300	February 15, 1864	April 10, 1871	Resigned
Sylvester Robinson	300	March 2, 1864		
L. B. Farrow	300	December 22, 1864	January 23, 1867	Resigned
Abner H. Gray	400	September 7, 1865		
Christopher Fulcher	400	September 7, 1865	January 15, 1869	Removed
William B. O'Neal	400	January 23, 1867	March 18, 1867	Resigned
Wallace R. Jennett	400	March 18, 1867		
Joseph E. Jennett	400	January 15, 1869	March 29, 1869	Resigned
Alpheus W. Simpson, Sr.	400	March 29, 1869	April 13, 1869	Declined
C.P. Farrow	400	April 13, 1869	June 29, 1871	Resigned
Zion B. Jennett	400	April 11, 1870	October 28, 1870	Resigned
Nana S. Williams	400	October 28, 1870		
Louis C. roach	400	June 29, 1871		
Alpheus W. Simpson	425	July 22, 1878		
Tillman F. Smith	425	November 19, 1878		
Selwyn Hause	425	November 30, 1878		

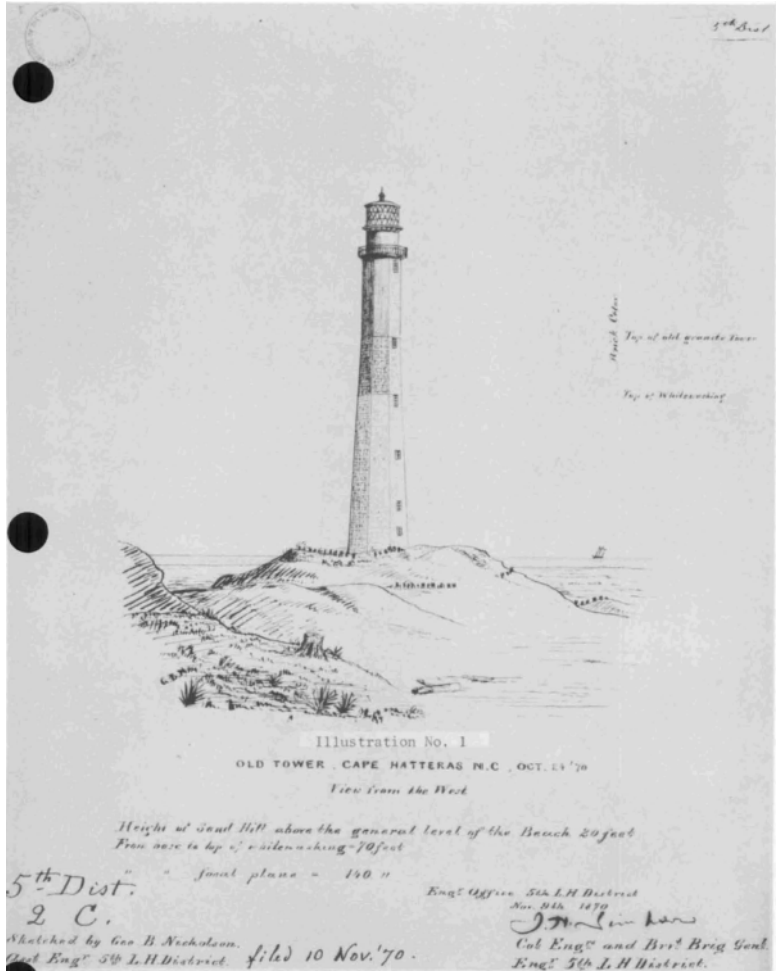
Name	Annual Salary	Date of Appointment	Date of Vacation	Manner Vacated
Joseph B. Whitehurst	$400	July 22, 1878		
John E. Whitehurst	400	April 17, 1879		
T. F..Smith	400	December 18, 1879		
J. E. Whitehurst	400	December 18, 1879		
F. E. Simpson	500	November 17, 1893	January 1. 1900	Transferred
Sanders B. Smith			January I, 1900	Promoted
A1pheus W. Simpson	425	January 13, 1894	May 16. 1899	Transferred
John B. Jennett	425	June 7, 1889	March 5, 1903	Transferred & promoted
Martin G. Fulcher	450	January I, 1900	April 4. 1905	Transferred
Amasa Fulcher	425	March 10, 1903	March 30. 1904	Transferred
John B. Quid1ey	425	April 1, 1904	October 16. 1905	Transferred
Issac C. Meekins	450	April 10, 1905	April I, 1906	Transferred
Thomas H. Baum	500	April 10, 1905	December I, 1905	Transferred & promoted
W. G. Fa1som	425	April 1, 1905	April 15. 1905	Service terminated
A. W. To1son*	500	April 27, 1905		
William G. Robinson	425	October 16, 1905	January 11. 1906	Transferred & promoted
A1pheus B. Willis	500	December I, 1905		
Charles H. Fulcher	450	April 1, 1906		

*See Chief Clerk, Lighthouse Board to 5th District Inspector. Washington. April 27, 1905. File No. 860; "Lighthouse Keepers and Assistant Keepers, 1872-1880"; "Lighthouse Keepers and Assistant Keepers, 1653-1871. Districts 1-6"; "Record of Light Keepers. 1st to 5th Districts, 1896-1907"; all in Record Group 26, National Archives.

ILLUSTRATIONS

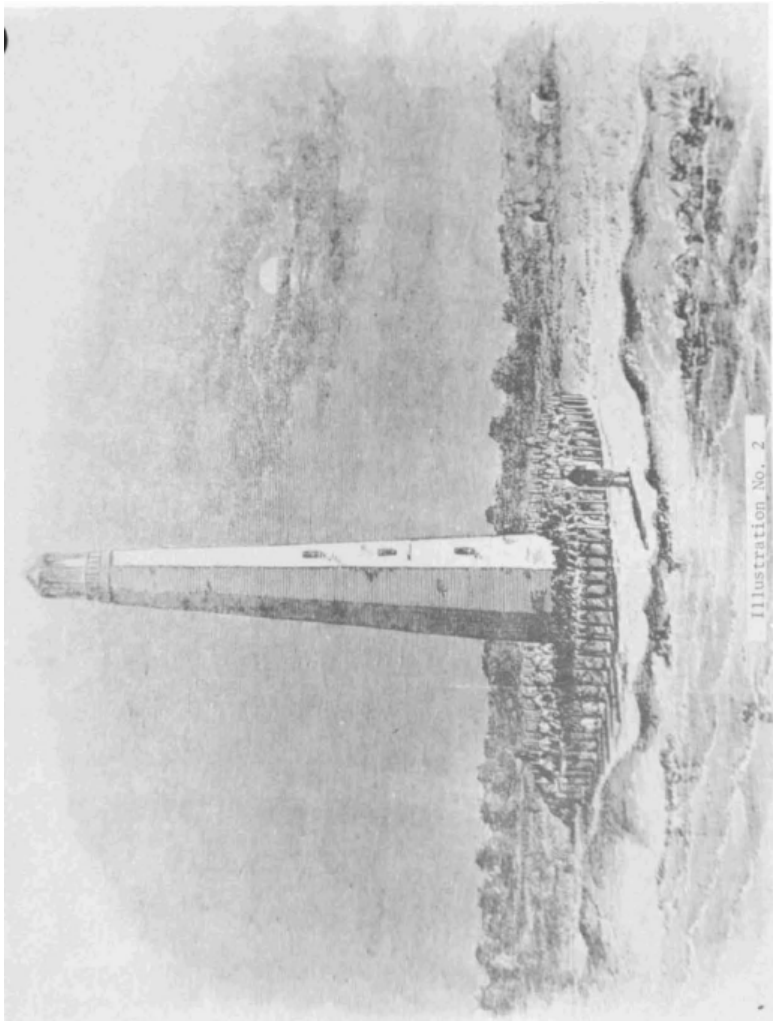
Old cape Hatteras light tower, 1870.
Note addition to original structure.
From Site File, Cape Hatteras Light Station,
R.G. 26, National Archives.

ILLUSTRATION 1



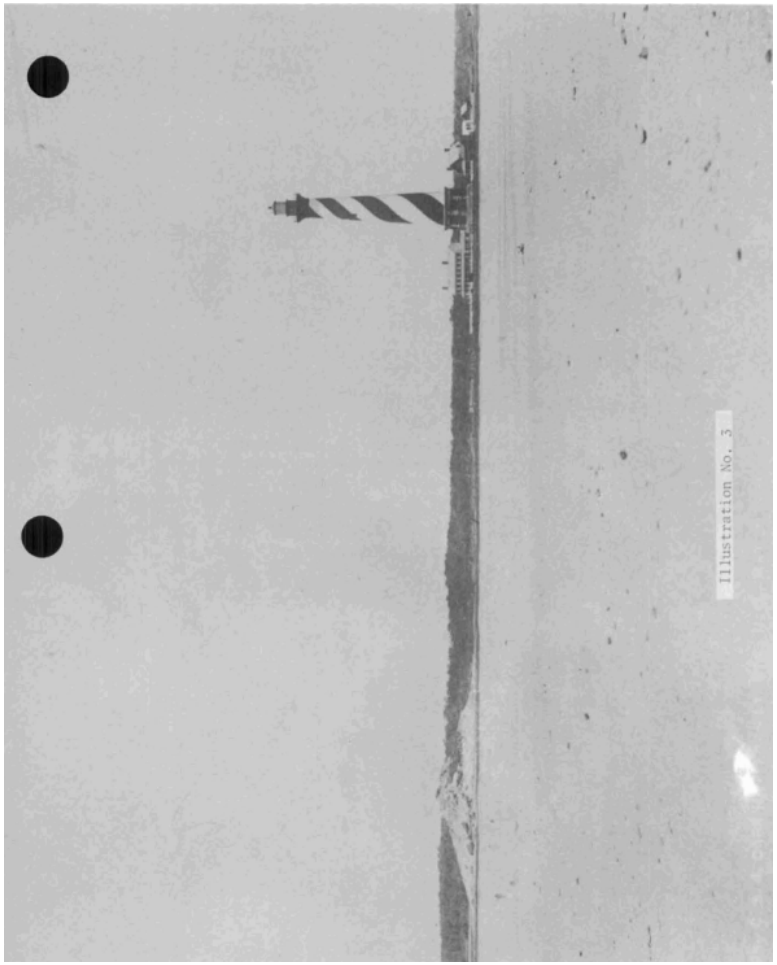
Troops bivouacked around Cape Hatteras light tower in 1861. From *Frank Leslie's Illlustrated Newspaper.*

ILLUSTRATION 2



Cape Hatteras Light Station, 1893. Mound to left of picture is site of the first Cape Hatteras tower. Photo from Engineering Files, 5th Coast Guard District Headquarters.

ILLUSTRATION 3



Cape Hatteras Light Station, 1893.
From Engineering Files, 5th Coast
Guard District Headquarters.

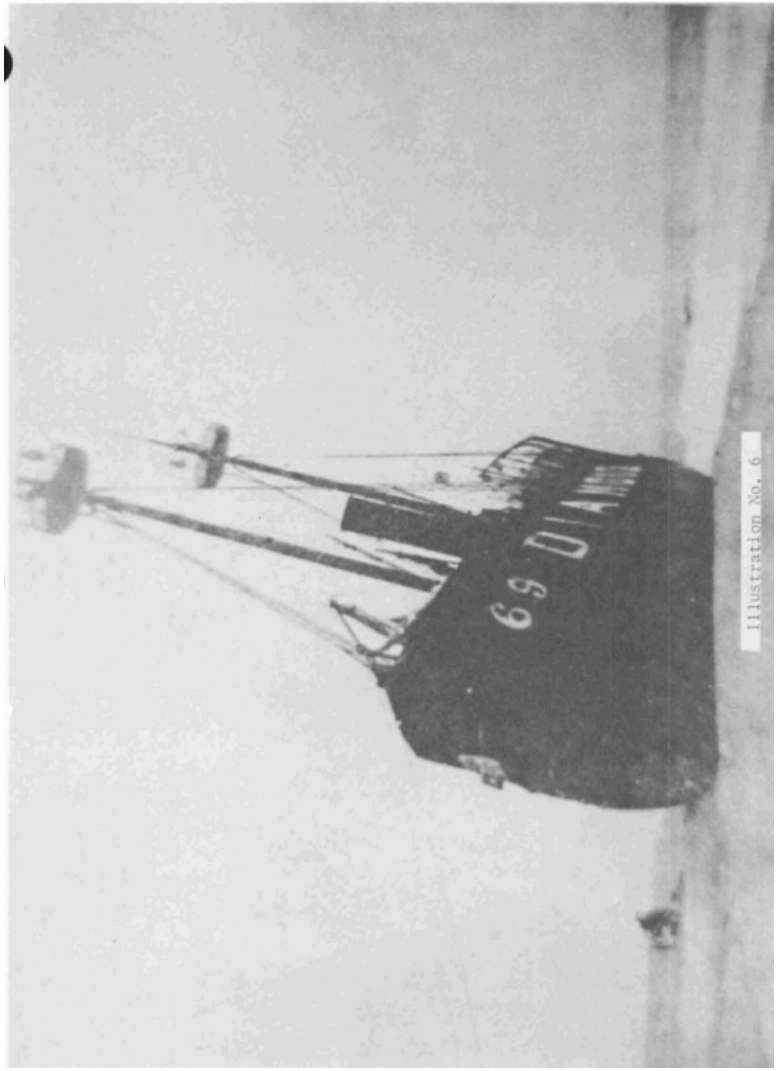
ILLUSTRATION 4

Cape Hatteras light tower, 1893. Mound to right is site of original tower. From Engineering Files, 5th Coast Gard District Headquarters.

ILLUSTRATION 5

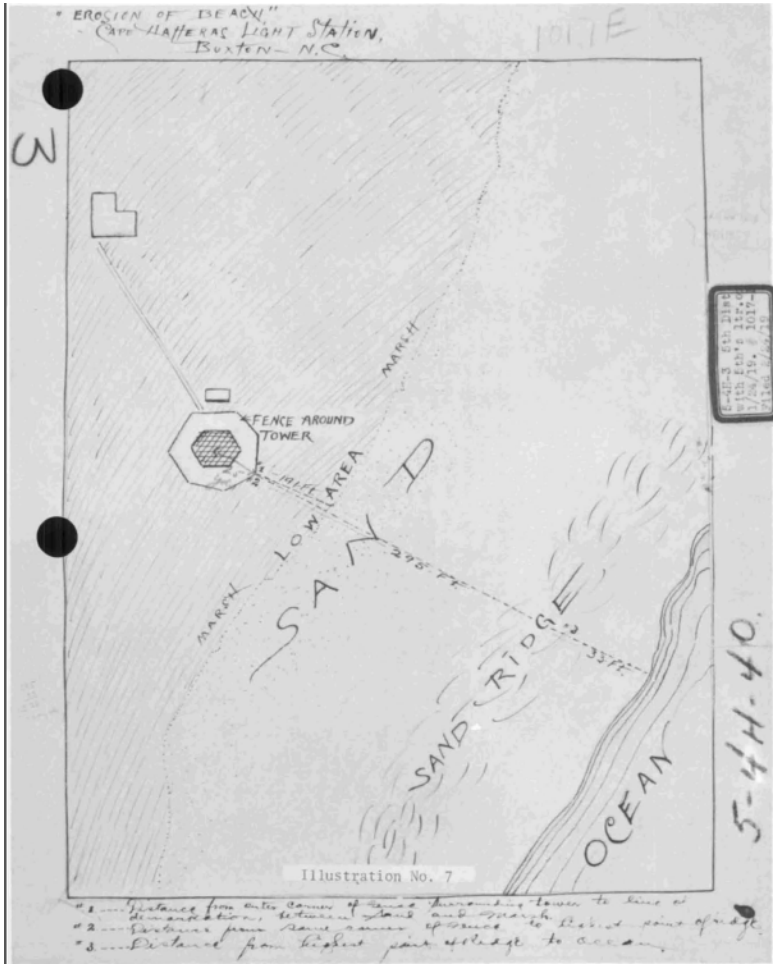
Diamond Shoals Lightship driven ashore by a storm in 1890's. From G.R. Putnam, *Lighthouses and Lightships of the United States (Boston: 1917).*

ILLUSTRATION 6



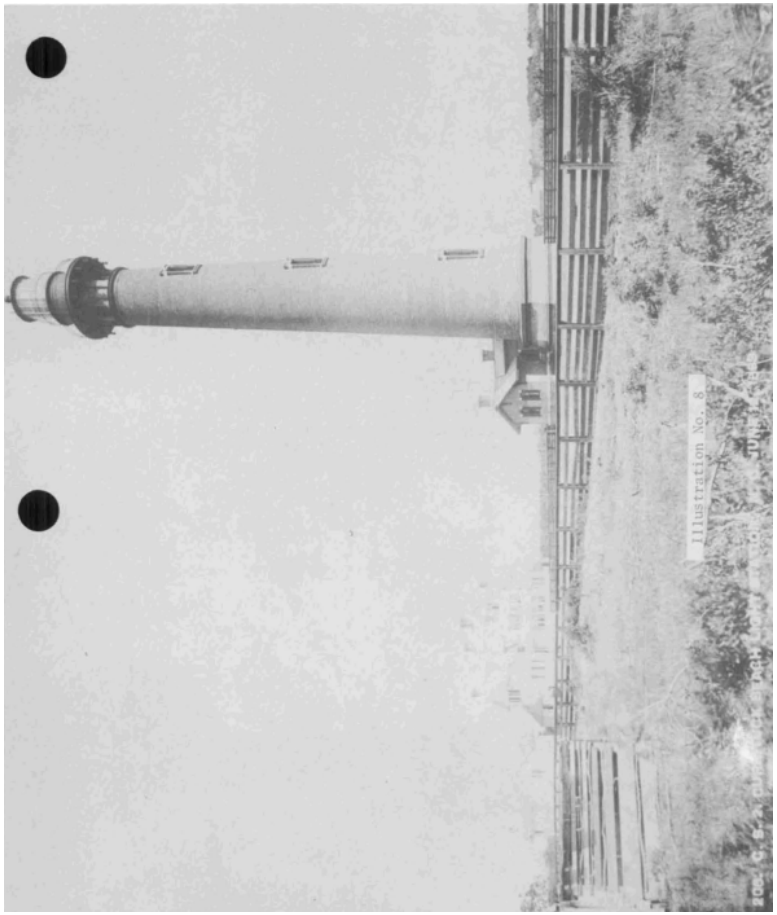
Erosion at Cape Hatteras Light Station, c1919. From Site Field, Cape Hatteras Light Station, R.G. 26, National Archives.

ILLUSTRATION 7



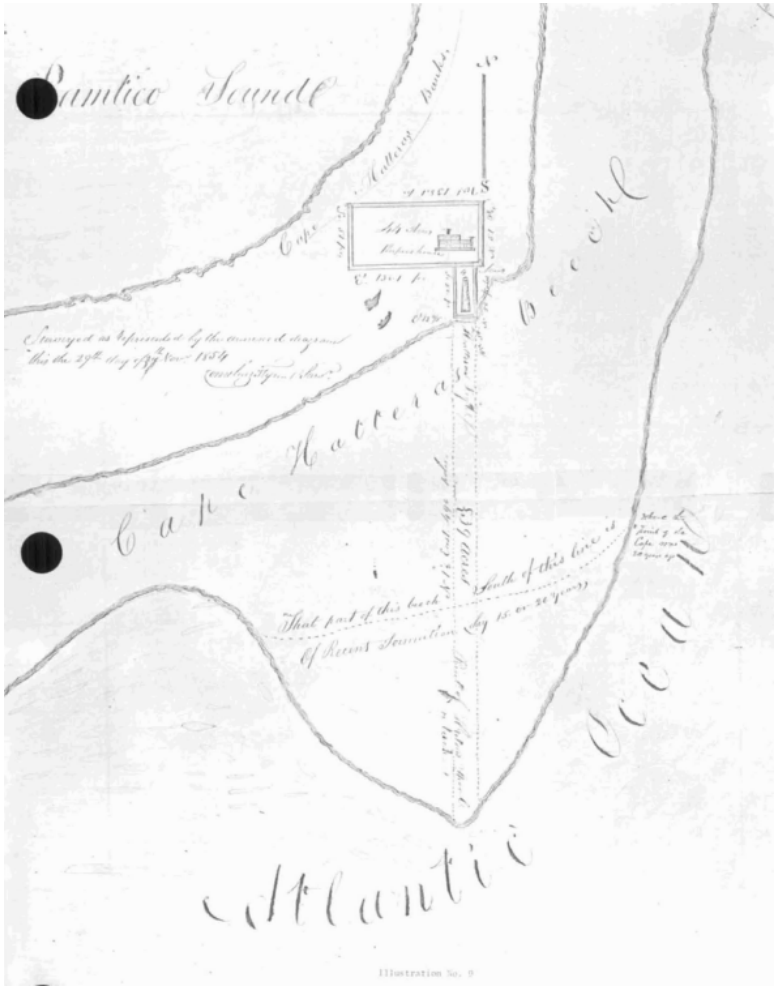
Currituck Light Station in 1893. This station was established in 1875 to light the darkened area between Bodie Island and Cape Henry. Photo from Engineering Files, 5th Coast Guard District Headquarters.

ILLUSTRATION 8



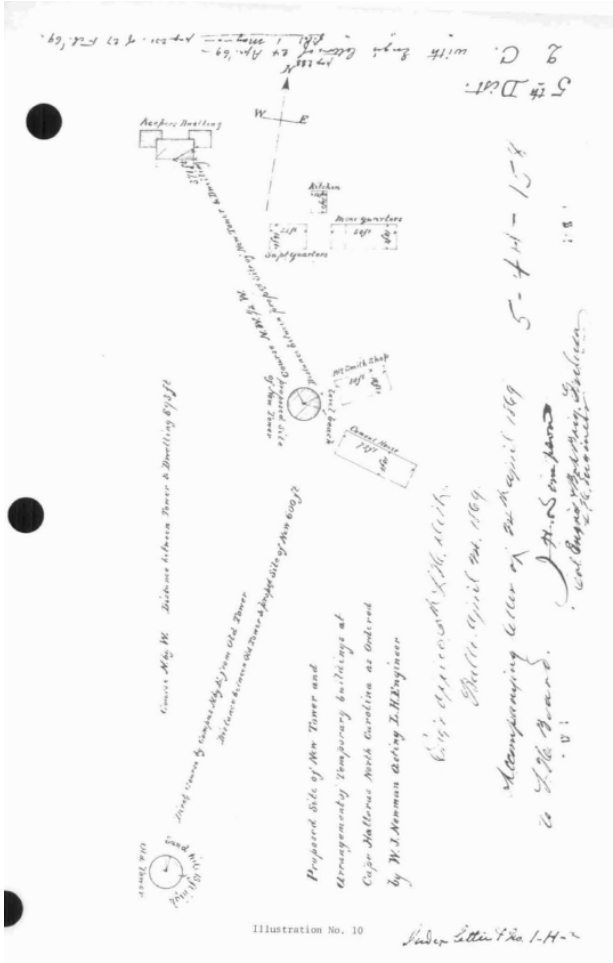
Layout of Cape Hatteras Light Station in 1854 showing accretion of land. From Site File, Cape Hatteras Light Station , R.G. 26, National Archives.

ILLUSTRATION 9



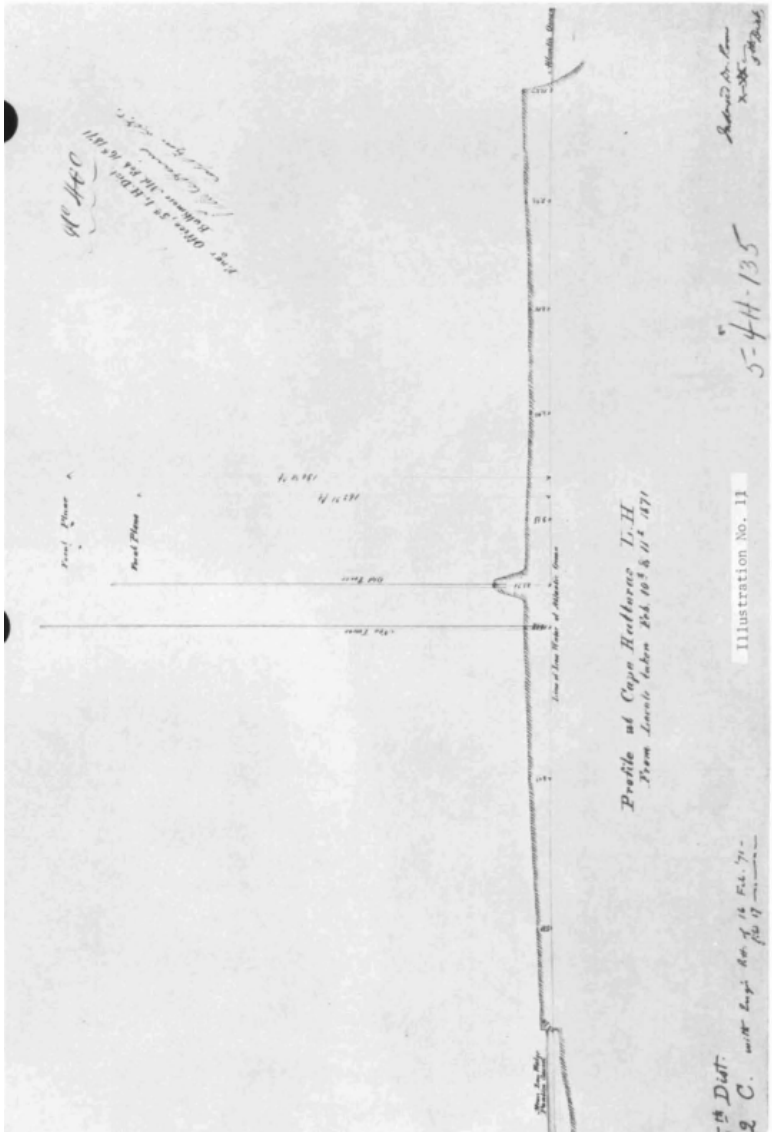
Layout of Cape Hatteras at time of constructing new tower. From Engineering Files, 5th Coast Guard District Headquarters.

ILLUSTRATION 10



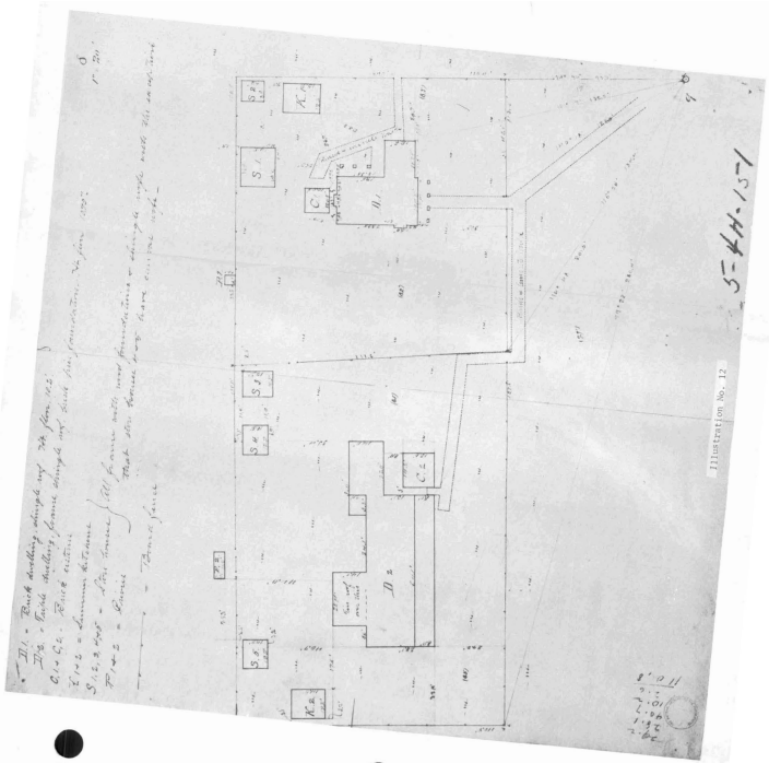
Land profile at Cape Hatteras, and comparison of focal places of new and old tower. From Engineering Files, 5th Coast Guard District Headquarters.

ILLUSTRATION 11



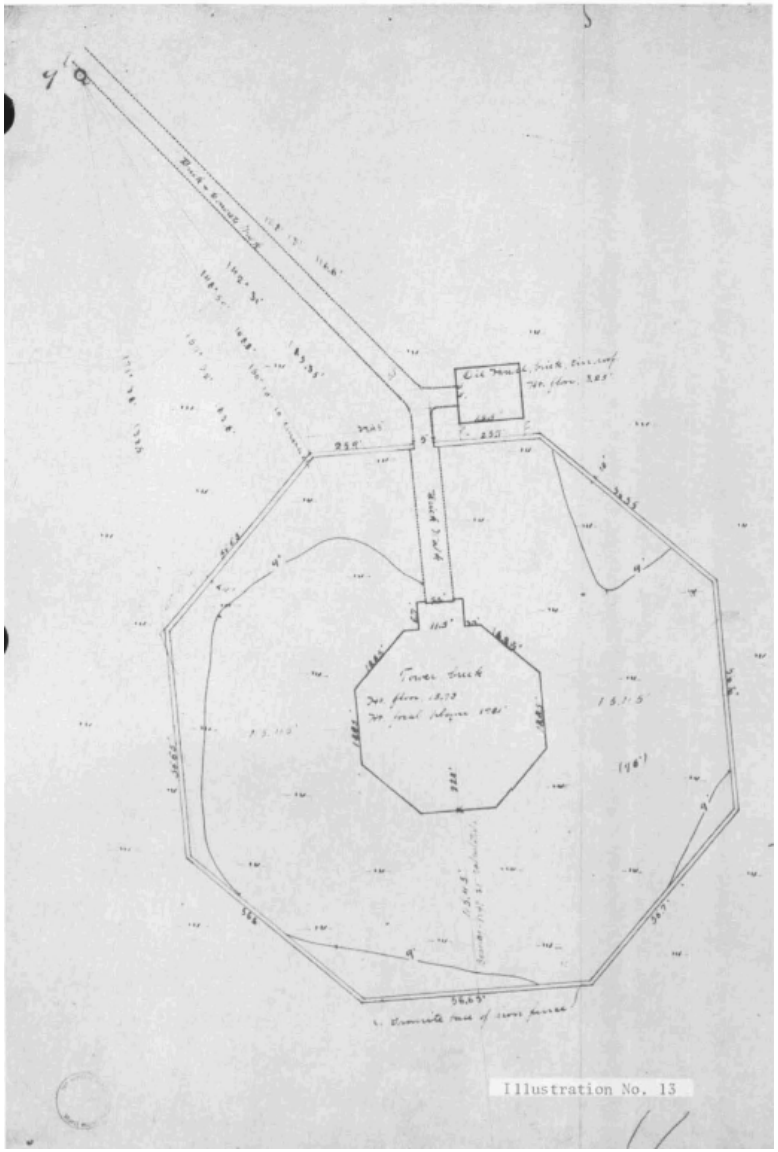
Layout of Cape Hatteras Light Station residence are showing measurements of buildings, etc. c1890. From Site File, Cape Hatteras Light Station, R.G. 26, National Archives.

ILLUSTRATION 12



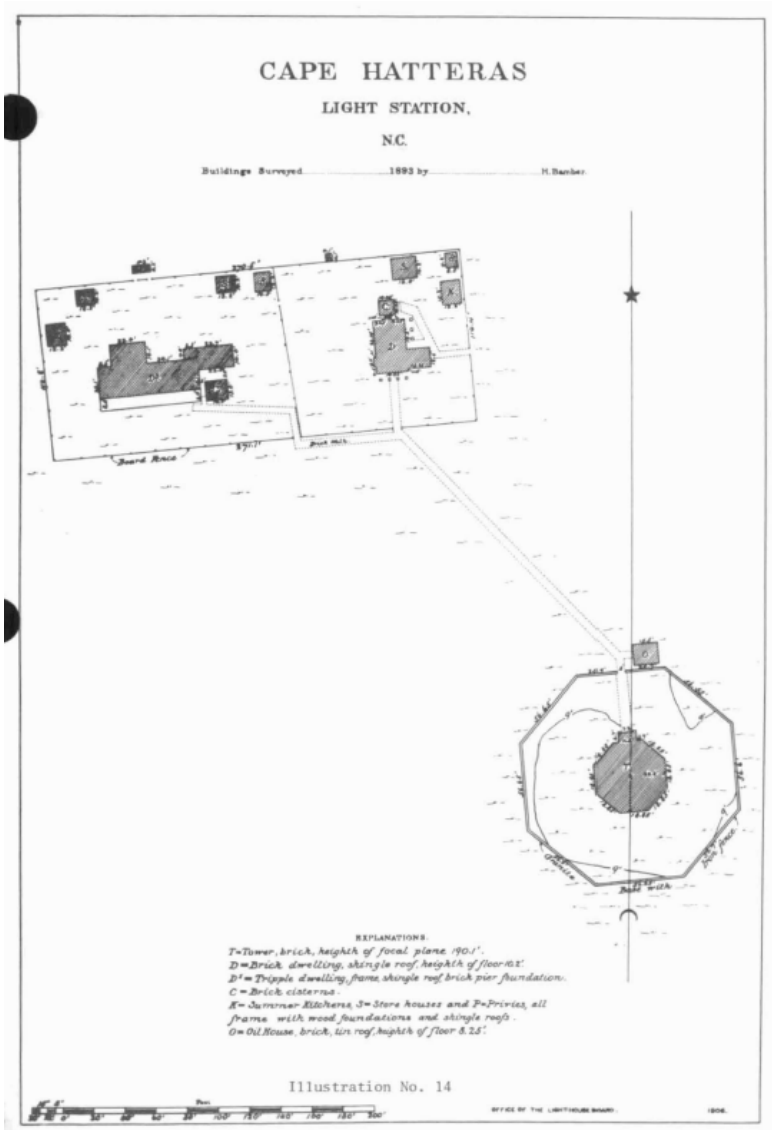
Layout of tower area of Cape Hatteras Light Station showing measurements. From Site File, Cape Hatteras Light Station, R.G. 26, National Archives.

ILLUSTRATION 13



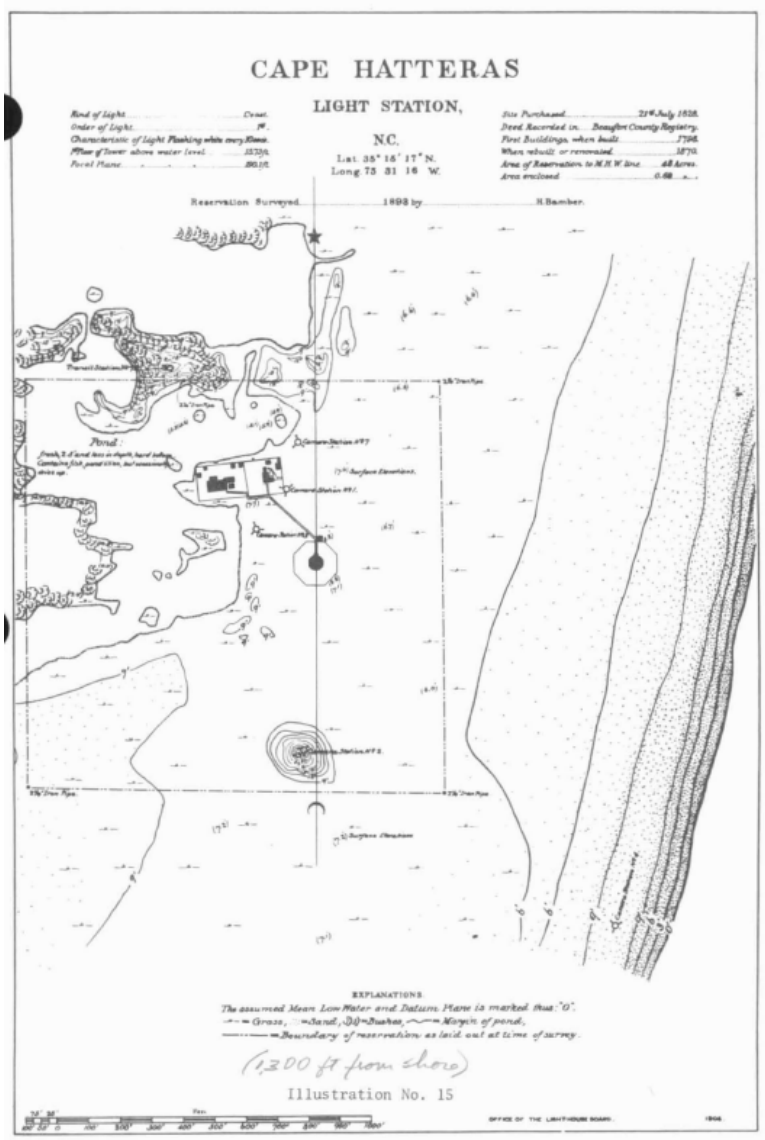
Layout of Cape Hatteras Light Station, 1893.
From Engineering Files, 5th Coast Guard District Headquarters.

ILLUSTRATION 14



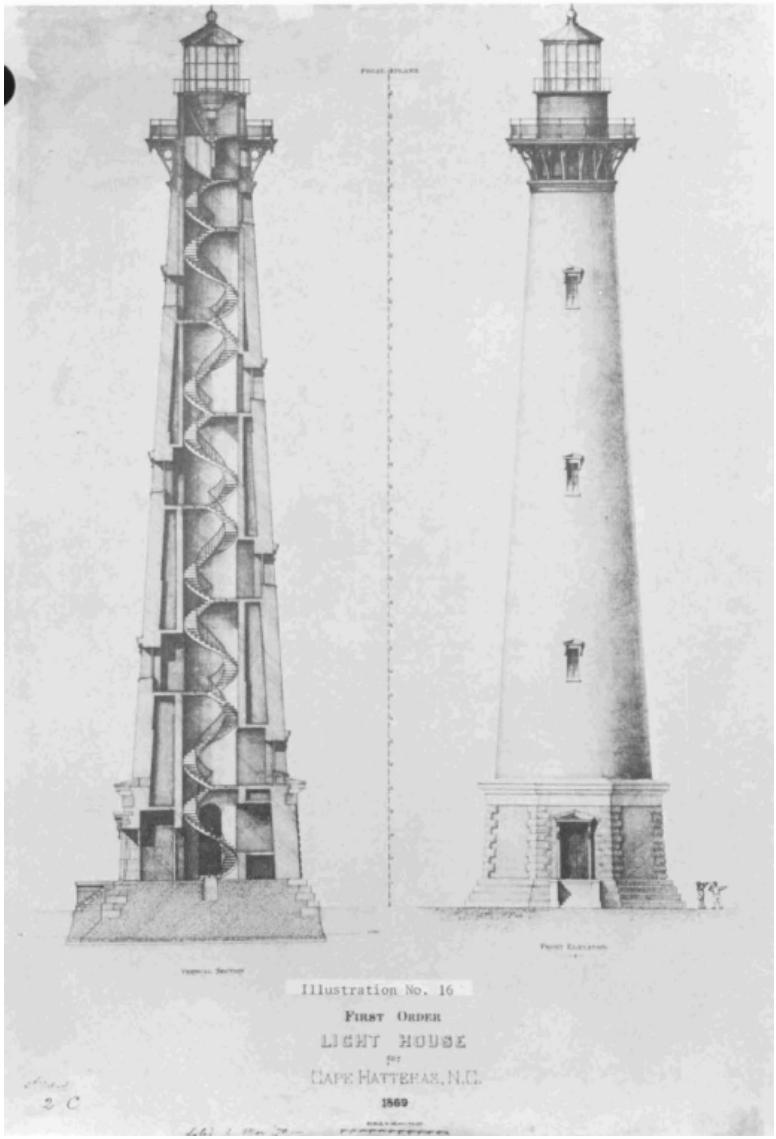
Layout of Cape Hatteras Light Station showing shore line, 1893. From Engineering Files, 5th Coast Guard District Headquarters.

ILLUSTRATION 15



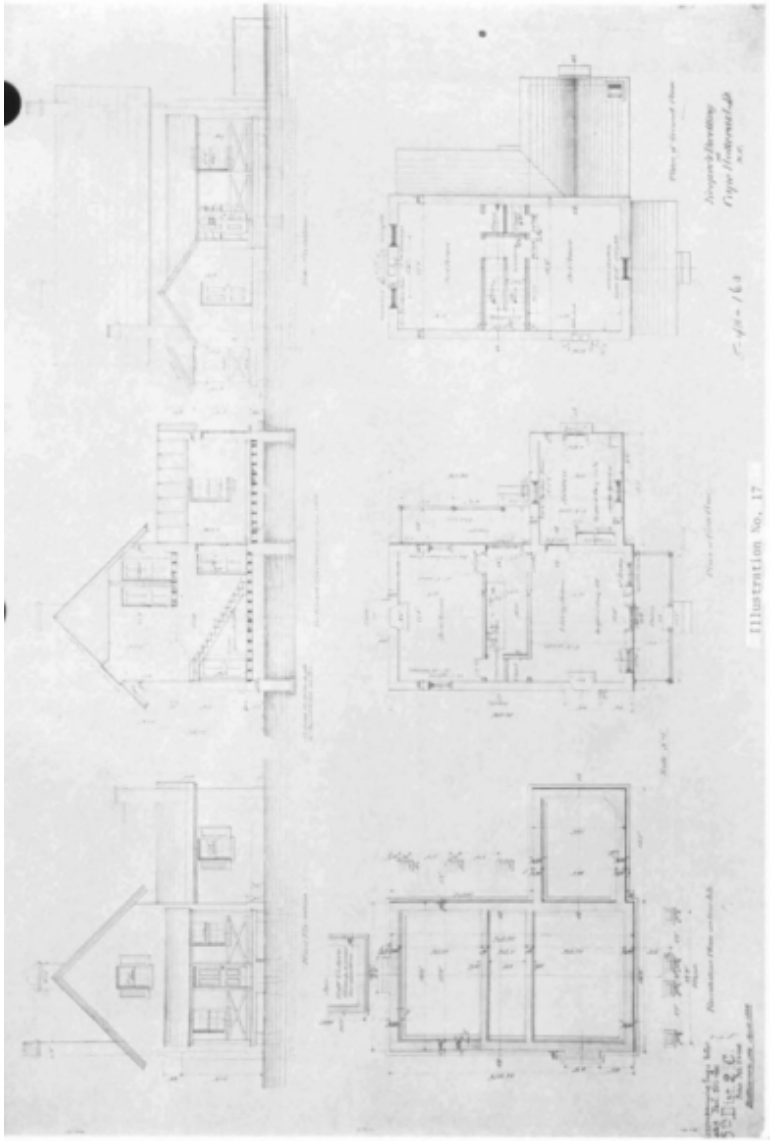
Front and half-sectional view of present Cape Hatteras Light Tower. From Site File, Cape Hatteras Light Station, R.G. 26, National Archives.

ILLUSTRATION 16



Plans of principal keepers dwelling, Cape Hatteras Light Station. From Engineering Files, 5th Coast Guard District Headquarters.

ILLUSTRATION 17



Drawings of double keepers' dwelling, Cape Hatteras Light Station, 1889. From Engineering Files, 5th Coast Guard District Headquarters.

ILLUSTRATION 18

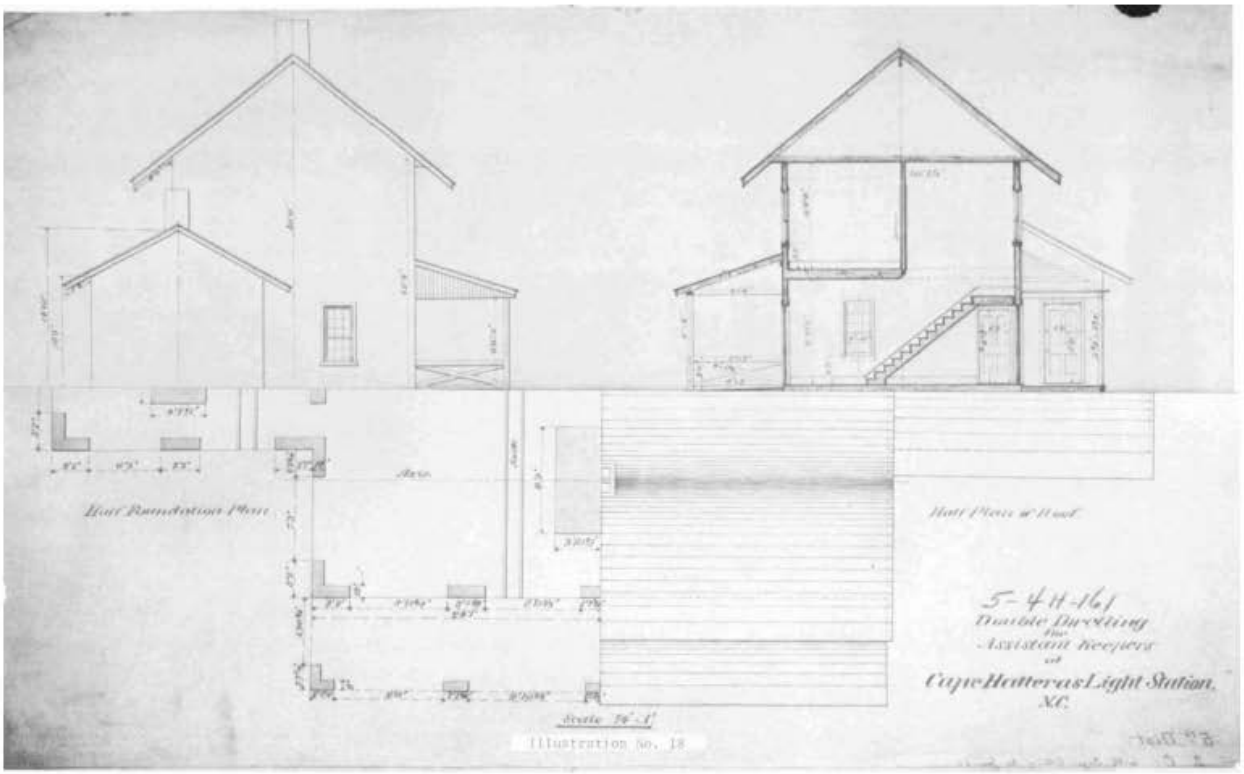
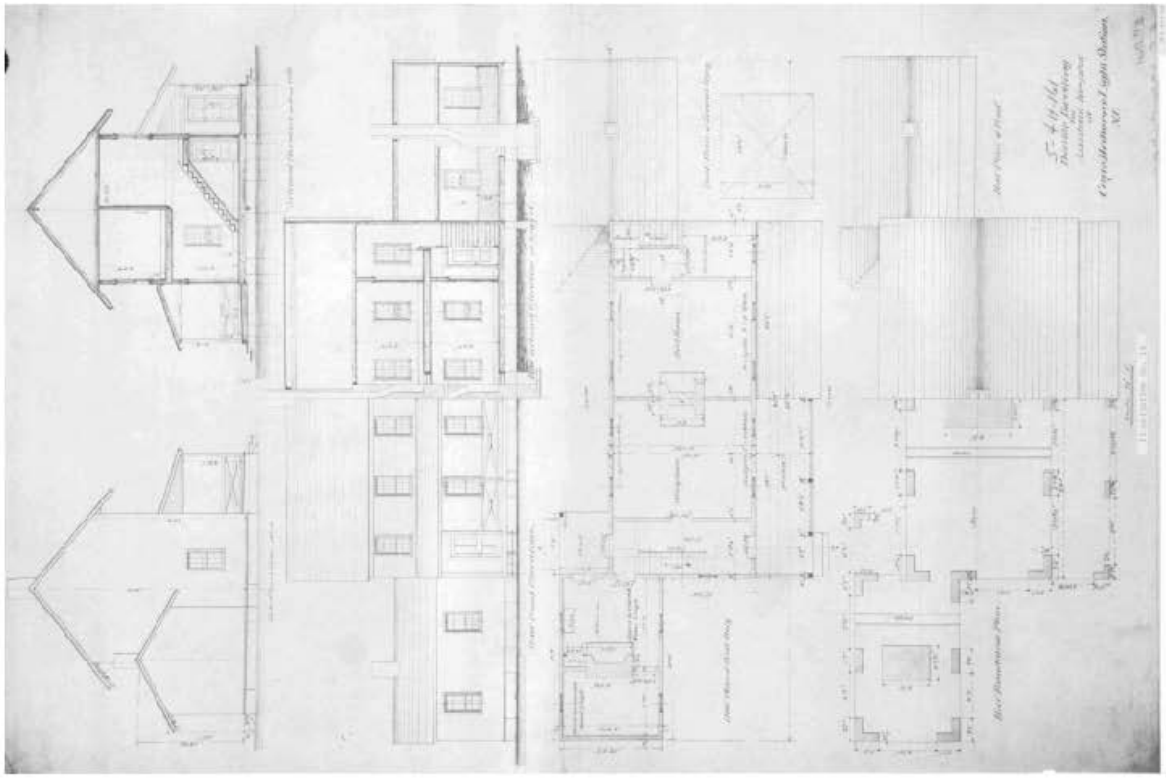


Illustration No. 18



Appendix F

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Appendix F: 1869 Specifications & Drawings

U.S. Lighthouse Establishment. "Specifications for a First-Order Light-House to be erected at Cape Hatteras, North Carolina." Government Printing Office: Washington, DC, 1869

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U.S. LIGHTHOUSE ESTABLISHMENT

Specifications

for a

FIRST-ORDER LIGHT-HOUSE

to be erected at

CAPE HATTERAS, NORTH CAROLINA.

Washington. GPO.

1869.

LIGHT-HOUSE

FOR

CAPE HATTERAS, NORTH CAROLINA

PROPOSALS FOR THE METAL WORK OF A FIRST ORDER LIGHT-HOUSE TO BE ERECTED AT CAPE HATTERAS, N.C.

TREASURY DEPARTMENT,

OFFICE OF THE LIGHT-HOUSE BOARD,

WASHINGTON CITY, _____, 1869.

SEALED PROPOSALS will be received at this office until 1 o'clock of Friday, the _____ day of _____, 1869, for furnishing the materials and labor of all kinds necessary to construct, erect, and complete at the workshop, and deliver on board a vessel or vessels at the port of either Baltimore, Philadelphia, or New York, the metal work for a First Order Light-house, at Cape Hatteras, North Carolina, in accordance with the accompanying drawings and specifications.

All the masonry work, together with the glass for the lantern, the lens, and lamps, and the furniture belonging to them, will be provided by the Light-house Board, and their cost is not to be included in the amount of the bid.

The bid should state the sum for which the entire work will be completed as aforesaid, and should also state the time required.

The work will be carried on under the personal supervision of an agent of the Board, and all facilities must be afforded him for inspecting the material and workmanship. Such parts of either as are not in accordance with the drawings and specifications will be rejected, and must be made good by the contractor.

The Board reserves the right to reject any proposal for any reasons it may deem sufficient.

Each bid must be accompanied by a written guarantee, signed by the bidder and competent surety, (certified to be such by some office known to the Treasury Department,) in the sum of five thousand dollars, ($5,000,) that in the event of the acceptance of such bid the necessary contract will be entered into within 10 days after notice is given by the Board that the bid has been accepted.

Bond and security, in the sum of five thousand dollars, ($5,000,) for the faithful performance of the contractor, will be required.

A copy of the plans and specifications must be enclosed with the bid as evidence as to the object of the proposal.

All proposals must be signed, sealed, and endorsed "Proposals for the Metal Work of a First Order Light-house at Cape Hatteras, North Carolina," and then enclosed in another envelope and directed, prepaid, to the Chairman of the Light-house Board, Treasury Department, Washington, D.C.

Any bidder may be present and witness the opening of the bids at the time and place hereinbefore specified.

Payments for the work will be made quarterly, upon estimates certified to by the agent of the Board; but twenty per centum of the amount of each estimate will be withheld until satisfactory completion of the contract.

W. B. SHUBRICK,
Chairman.

FORM OF BID

_____

_____

_____

_____

I, (or we,) the undersigned citizen of _____, in the county of _____, and State of _____, hereby agree to furnish all the materials and labor necessary to construct, erect, and complete the metal work, (except the lens, lamps, and other furniture belonging thereto,) for a First Order Light-house at Cape Hatteras, North Carolina, in accordance with the accompanying specifications and drawings, the work to be completed on or before _____ of _____, 187_, for the sum of $_____

(Signed) _____

To Rear Admiral W. B. SHUBRICK,
Chairman Light-house Board,
Washington, D. C.

Know all men by these presents, That we,

are held and firmly bound unto the UNITED STATES OF AMERICA in the full and just sum of five thousand dollars, lawful month of the United States, to be paid to the said United States, or to its proper agent or attorney duly authorized to receive the same to which payment, well and truly to be made and done, we bind ourselves and every of use, our and every of our heirs, executors, and administrators, in the whole and for the whole, jointly and severally, firmly by these presents. Sealed with the seals and dated this

day of anno Domini one thousand eight hundred and

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH, That if

heirs, executors, and administrators, do and shall well and truly, within ten days after notice of acceptance of his or their bid, enter into contract for the construction, erection, and completion of the metal work of a First Order Light-house at Cape Hatteras, North Carolina, in accordance with the terms of his bid dated , conforming in all respects to the advertisement dated , calling for proposals, the same being hereto annexed, then the foregoing obligation to be void and of none effect; otherwise, to remain in full force and virtue in law.

Signed, sealed, and delivered

*in presence of*__

[L.S.]

[L.S.]

[L.S.]

[L.S.]

I CERTIFY, That I am acquainted with

the suret named, and who executed the foregoing writing obligatory, and that

residents of

and in my opinion sufficient surety for the purposes mentioned in the above bond.

NOTE.—This certificate must be signed by some

Officer known to the Treasury Department.

U. S. LIGHT-HOUSE ESTABLISHMENT.

S P E C I F I C A T I O N S

FOR A

FIRST ORDER LIGHT-HOUSE

TO BE ERECTED AT

CAPE HATTERAS, NORTH CAROLINA

==========
PREPARED AT THE OFFICE OF THE LIGHT-HOUSE BAORD, TREASURY DEPARTMENT.
==========

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1869.

SPECIFICATIONS

FOR A

FIRST ORDER LIGHT-HOUSE

AT

CAPE HATTERAS, NORTH CAROLINA.

The dimensions, details, and general arrangements, are to be as represented on the drawings, numbered from 1 to 18, both inclusive, and as herein described.

GENERAL DESCRIPTION.

The tower consists mainly of two shells of brick work, (the outer one a hollow frustum of a cone, and the inner one a hollow cylinder,) connected together by means of twelve tie-walls, four of which radiate from the centre; the remaining eight are parallel, in pairs, and directly opposite each other, forming the two window recesses, 4 feet 6 inches wide in the clear.

Externally the light-house will present to the view (Plate No. 1) a conical shaft of red brick, rising from an octagonal base of brick and granite, resting upon a spreading octagonal plinth of four steps, the latter constructed of blocks of cut granite.

The shaft will be crowned with a capital 8 feet 9 inches high, comprising sixteen cast-iron brackets, which spring from a moulded necking, likewise of cast iron, and support a balcony (called, in these specifications, the "main gallery") of 28 feet extreme diameter, the edge of which is guarded by a railing of cast and wrought iron.

Above this gallery a cast-iron parapet, 7 feet 2 inches diameter, rises to the height of about 10 feet, and is surmounted by a lantern of sixteen sides, framed of cast and wrought iron, and bronze, which will contain thick plate-glass, and be covered with a pyramidal roof of copper, terminating at the apex with a spherical ventilator and a pinnacle.

Height of focal plane.

The height of the focal plane, or the centre of flame of the lamp, is to be 180 feet above the general level of the ground at the foot of the tower.

Position of tower windows.

At successive heights of about 20 feet the shaft is pierced by seven (7) windows, three of which are in line above the main entrance, and the four others are in the opposite side of tower. These windows are capped with heavy, projecting heads of cast iron, pedimental in form, supported upon iron consoles built into the wall.

Tower base.

The base will be 21 feet 9½ inches high from the top of the plinth to the commencement of the shaft. The entablature, or cornice of the base, will be of cut granite, and its faces will be of brick, the latter strengthened at the corners by heavy quoins of granite.

Entrance.

The entrance-doorway, in one of the faces of the base, is reached by a flight of eight (8) granite steps.

Stairway.

A vestibule or passage, 4 feet 6 inches wide, leads within to a cylindrical well, 11 feet 6 inches diameter, containing the iron stairs, which rise in a spiral from left to right. The ascent from the tower floor to the watch-room floor is divided by eight (8) semicircular landings into nine (9) flights, seven (7) of which comprise steps of 12 degrees tread, thirty (30) in number, giving each flight a complete revolution of the circle. The eighth flight makes half a revolution, and comprises fifteen (15) treads, of 12 degrees each. The ninth flight has fourteen (14) treads, of 10½ degrees each. This last flight is cased in, and has an iron door at the foot to prevent the draught interfering with the light.

Enclosed stairs.

Lantern stairs.

The interior lantern-gallery is gained from the watch-room floor by a separate, narrow flight of twelve (12) steps.

Position of landings.

The landings occur alternately on opposite sides of the stair-well, each lighted by a window, the lowest one being on the side of tower opposite the door.

Height of landings.

The height from surface to surface of landings is 20 feet and ¼ of an inch, except the upper landing, forming the service-room floor, the surface of which is but 10 feet 4 inches above that of the arched landing next below.

Service-room windows.

The service-room is lighted by three windows, placed ninety degrees (90°) apart, each formed of a single plate of thick, rough glass, set in the iron paneling between the main-gallery brackets.

Iron floors and arched landings.

Tiled floors.

The watch-room and service-room floors are of cast iron. The seven landings below are supported by brick arches, springing from rolled wrought-iron beams and the wall of the well. The surface of each of these landings is covered with square tiling which extends into the window recess.

Parapet door and ladder.

A doorway in the parapet opens out on to the main gallery, from which an iron ladder leads up to the outside lantern-gallery.

EXCAVATION.

The foundation-pit (see Plate No. 1) must be excavated to a depth of about 7 feet, or sufficiently to reach 18 inches below the level of low water, and the bottom of the pit suitably level for platform of timber. The excavation to include a pit 12 feet wide for foundation of entrance-stoop. (See, also, Plate No. 4, Fig. 10.) A portion of the excavated material must be rammed hard against the outside of the foundation as it proceeds, and the remainder will be graded around the premises, as may be directed.

FOUNDATION PLATFORM.

Timber.

The platform upon which the foundation is to be laid will be octagonal in plan, 12 inches thick, and not less than 48 feet diameter across the opposite sides. The timber to be of heart yellow pine, in sticks of a uniform thickness of 6 inches, and of widths which may vary from 7 inches to 12 inches, laid in two courses, crossing at right angles, and fastened through and through with yellow-pine pins, of 1½ inch diameter, driven about 2½ feet apart.

WOOD WORK.

Location of doors.

Besides the timber platform, the only other wood work belonging to the tower consists of two doors, one inside the vestibule, and the other in the watch-room, opening to the main gallery at the top of tower. The first is shown upon and described under Plate No. 5; the latter on Plate No. 14.

STONE WORK.

PLATES NOS. 1, 3, AND 4.

Rubble.

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 at the light-house site, or conveniently landed, if it be necessary to transport them. 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 grantie, 1 foot 7 inches thick, upon which will be laid the cut-granite blacks forming the lower course of the plinth, which will also be 45 feet 6 inches diameter.

Cut Stone.

Plinth, Figs. 1 to 5, and Pl. 4, Figs. 3 and 5.

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.

Courses of plinth, Pl. No. 3, Figs. 1 to 5.

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 wide, 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 perpen-dicular cutting projects horizontally 2½ inches, to form a bed for the quoins.

Size of stones.

The stones forming the plinth will all measure 3 feet 4 inches in length on the face, and break joints. For their penetration into the rubble-work of the plinth, refer to plans of courses, Plate No. 3, Figs. 1 to 5, and Plate No. 4, Fig. 5.

The rubble will be carried up to within 6 inches of the top of the plinth.

Beds, &c.
Joints.

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, excapet the 4th and 5th, will be continuous around its perimeter.

Plinth courses at sill.

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. Footings of radial walls.

The stone E, Fig. 5, must be firmly bedded in the rubble-work, for the purpose of receiving the thrust of the 1st flight of tower stairs, and will be cut out to accommodate the flange and bolt heads on the under side of the foot plate. (See, also, Plate No. 4, Elevation of joints, C D.) Bed of foot-plate.

Quoins.—Plate No. 4, Figs. 1, 2, 15, to 17.

The quoins (cut right and left) are of granite, eighty (80) in number, ten built in at each angle of the base; 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. Number and size. Edges tool-drafted.

Cornice.—Figs. 1, 2, 11 to 14.

The cornice which caps the base is composed of four (4) courses of granite, comprising the crown, fascia, bed-mould, and frieze, lettered A, B, C, and D, respectively. These are shown in section and half elevation at Figs. 1 and 2, and in half plan at Figs. 11 to 14. The stones of the crown or top course will be cut with a level bed, 32 feet 5½ inches diameter, for commencing the brick shaft upon. At from 2 to 4 inches below this bed the crown will begin its slope. The stones are continued entirely through the outer wall of tower by a second series or backing; the outer stones to be held firmly together with strong clamps of 1½-inch by ¾-inch wrought iron, 12 inches long, let into the upper surface and run with lead. (See Fig. 11.) In this figure, the recess of window No. 1 is indicated, showing the cutting required by the stones at its sides. Crown of cornice. Iron clamps.

Entrance Stoop.—Plate No. 4, Figs. 3, 4, and 6 to 10.

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, (Fig. 6,) and are confined between two cheeks or buttresses, which are cut with rests for the ends of the steps and platform, (Figs. 7 and 8.) 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. Steps, platform and sill. Cheeks. Cheek coping.

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. Slope of steps, &c.

A foundation of rubble masonry, resting upon a continuation of the timber platform, (See Fig. 10,) will support the stoop, and be built up to form a bed under each step. Stoop foundation.

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. (See Elevation of Stones, H and I; also, Plate 3, Fig. 5.) Underside of sill must not touch.

Tower Entrance.—Plate No. 3, Figs. 6 to 11.

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. Granite doorway.

The skew-backs, (Fig. 13,) key, and intermediate stones of the pediment, (Fig. 6,) penetrate well into the wall, (Fig. 7,) and their upper surfaces are dressed to give the brick work a level bed. (See Fig. 6.)

The cheeks of the entrance as far in as the iron door (Figs. 7 and 8) are faced up with slabs of granite 8 inches thick.

The outer corners of the entrance (see Fig. 9) will be formed of three pieces in height, cut out of blocks 16 inches square.

The lintel, (Figs. 10 and 11,) each console, (Figs. 14 to 18,) and the horizontal fascia of the pediment, are cut out of single stones, and fitted together in the neatest manner with cement joints. Lintel, &c.

Floor Tiling.—Plate No. 3, Fig. 7.

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 oil recess No. 3 will likewise be partly tiled. (See, also, Plate No. 7, Figs. 1, 2, 3.)

BRICK WORK.

PLATE NO. 2.

Quality of bricks.

The bricks throughout the structure must be of the best quality, hand-made, of an oven texture, hard-burned, and laid in the most solid manner, with full beds of mortar. They must be in all cases immersed in fresh water just before being used.

Bond of brick-work.

On the drawing, the walls are represented as being built with the "Flemish bond;" but in place of using that system, the whole of the brick work is to be laid up with *every third course* composed of headers, between which the other two courses will be stretchers; all the courses breaking joint. This method of bonding must be followed as nearly as possible throughout the entire thickness of all the walls.

Brick of the base.

The base of the tower is a frustum of an octagonal pyramid, 15 feet 10 inches high, from the top of the plinth to the bottom edge of frieze; the greater diameter of frustum is 37 feet 5 inches; lesser diameter, 35 feet 6 inches.

The insides of the wall of base will have an inclination parallel with the outside, preserving a uniform thickness of 5 feet 3 inches, or equal to the length of seven and one-half (7½) bricks. The inside of this wall will also be octagonal, in horizontal section, and be carried up thus to under side of the crown of the granite cornice, which latter runs entirely through the wall, forming a bed for the conical shaft.

Shaft of tower.

The brick shaft will be 125 feet 10¼ inches perpendicular height, from the base to the bottom edge of the belt course or necking, upon which the main brackets rest. At which height its outside diameter is 17 feet 2 inches, while at the base it 32 feet 5½ inches diameter, making the inclination of the cone or batter of tower seven-tenths ($^7/_{10}$) inch, or more accurately, .729 of an inch per foot in height.

Batter.

Offsets.

For a height of 104 feet 8½ inches, the inside and outside of the conical shell of brick work are parallel, but the thickness is reduced at intervals on the interior by three offsets, dividing the shaft into sections, as follows, viz: 1st section, from the cornice of the base, 10 feet 2½ inches high; 2d and 3d sections, 32 feet high each; 4th section, 30 feet 6 inches high.

Thickness of outer wall.

Size of bricks and joints.

The thickness of 1st section will be equal to the length of 5½ bricks, or about 3 feet 10¾ inches; above this, the sections will diminish successively by half a brick, or 4 inches. (These dimensions are determined by allowing a brick to be $8^1/_8$ inches long, 4 inches wide, and $2^1/_8$ inches thick, with interior mortar joints of $^3/_8$ inch thickness; the exterior joints will be about ¼ of an inch thick.)

Diameter and thickness of well.

The well containing the spiral stairs will be of a uniform inside diameter of 11½ feet, all the way up from the tower floor to the top of parapet. On its outside, the wall will be reduced in thickness at intervals of about 42 feet height, by two offsets of 4 inches each, the lowest section being 2½ bricks (about 21 inches) thick.

Intersection of walls.

Air space.

At the height of 126½ feet above the tower floor, the two walls join, and will be carried up together, being separated only by and air space 2 inches wide, spanned by the headers which tie the two walls at intervals of, say 3 bricks in every third course, thus securing an air communication throughout the height.

Parapet wall, &c.

Service-room wall.

The parapet lining, or wall of watch-room, will be built up solidly 1½ brick in thickness, the air space being contained between it and the cast-iron parapet outside; the lining of the service-room will be one brick or $8^1/_8$ inches thick, with an air space between it and the remainder of the brick work outside, which will be laid up closely against the paneling between the gallery brackets.

Brickwork laid close against castings, &c.

In all cases where iron work is to be built in the walls, the brick must be laid in close contact therewith, having a good joint of mortar between. The wall castings for the stair carriers and rolled beams, brackets, anchor-bolts, and other pieces, must be accurately set in place, and good beds of mortar be provided where required.

Thickness of tie walls.

From the foundation up, the thickness of the radial and other tie-walls will correspond with the thickness of the cylindrical wall where they attach to it. (See horizontal sections, Plate No. 2.)

Recess arches.

Semicircular arches, one (1) brick thick, over and under the window recesses, must be sprung between the tie-walls which form the recess jambs; similar arches must be turned above the oil recesses, and another will support the floor of recess No. 2.

Haunches leveled.

Bed for tiling.

All the arches must be filled up on the haunches and leveled off one course above the crown, with brick regularly laid in mortar; allowance being made for floating this surface with a bed of mortar for the floor tiling, which must be level with that of the stair landings. The faces of the arches *over* the recesses will curve in horizontal direction with the stairwell; and for supporting the wall of the latter, the arches must be increased to 1½ brick in thickness; they must also be tied into the outer wall of tower; the other arches to be well bonded at their ends into the wall.

Ends of arches bond into the walls.

Suitable wooden centres must be provided for the arches of both the recesses and the landing. The arches of these landings must be built in the most careful and substantial manner. (See Plate No. 7, Fig. 4.) Wooden centres.

Within each recess, brick benches, 5 feet long, 16 inches wide, and about 18 inches high, must be built one at each side, for elevating the oil tanks upon. Oil-tank benches.

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. Brick pavement.

Mortar, &c.

The stone and brick work throughout the structure will be laid in mortar, composes of one measure of hydraulic cement to two measures of sand, or of such proportions as may produce the strongest mixture. The sand must be clean, sharp, and free from salt.

The cement must be subjected to some reliable test to prove its strength; and to insure its acceptance, it must be of the best quality, fresh burned, well ground, securely packed in paper lined barrels, and kept dry till used, when it will be prepared only in quantities as needed. Cement.

METAL WORK

PLATE NO. 5

Main Entrance Details.

The vestibule will be provided with two double doors, the outer one to be of iron; the inner of wood, which latter will contain lights of glass in place of the middle and upper panels. Vestibule, Figs. 4 and 5.

The plan of vestibule is shown on Plate No. 3, Fig. 7.

Each fold of the outer door will be made of a plate of iron, $^1/_8$ of an inch thick, strengthened by stiles and rails of plate iron $^7/_{16}$ of an inch thick, and of different widths, forming panels. Iron door, Figs. 1, 3, and 4.

The stiles and rails will be secured with rivets $^3/_8$ of an inch diameter, driven about 5¼ inches apart, having neatly rounded heads both sides. At the meeting stile the rebate will be formed by a batten of iron 1¾ inch wide by $^3/_8$ inch thick, riveted on. (See Figs. 2 and 3.) Rivets, &c.

The door must be provided with a substantial brass lock, keys, and knobs. Heavy bolts of wrought iron must be likewise attached to the head and foot of each door, and mortises cut in sill and lintel. Locks, bolts, &c.

Cast iron pockets (not shown in the drawing) must be let into the floor of passage to receive the lower bolt of each door when opened. Floor pockets for door-bolts.

Both door-frames will be alike, except in that the doors, being of different thickness will require some modification in their respective jambs. Door-frames.

The sills, jambs, lintels, and transom rails, (or imposts,) will be cast in separate pieces, and all be secured together with wrought iron bolts and nuts, ¾ of an inch diameter.

The jambs of each frame will measure 8 inches wide against the wall, and have an ogee moulding on the inner edge. Door jambs, Fig. 8..

The general thickness of iron will be $^3/_8$ of an inch, but increased to ¾ inch behind the hinge recesses for receiving the tap-screws.

To secure the jambs to the wall, flanges 4½ inches wide, $^3/_8$ inch thick, running up the whole length, will be built into the brick-work; these flanges to be tied by two triangular webs, $^3/_8$ inch thick, placed about 4 feet apart. Flanges.

The same jamb patterns (right and left) can be used for both frames, by making a slight modification in the door rebate, as mentioned above. Patterns modified.

Three (3) pairs of hinges of bronze, (composed of 9 parts copper and 1 part tin,) to be provided for each fold of the iron door, and permanently secured to the jambs before the latter shall be built in the wall. Hinges for outer door.

The hinges for the inner door will be of a different pattern, and attached so that when the doors are closed, the hinges will be folded and only the joints be seen. Hinges for wooden door.

The hinges for iron door to be 6 by 6 inch, and $^3/_8$ inch thick; pins, ½ inch diameter, with head, to prevent working through. Hinges for wooden doors to be finished to fit their places; pins, $^3/_8$ inch diameter. Size of hinges.

Tap-screws of wrought iron, or rivets, ($^3/_8$) inch diameter in either case,) will secure the hinges to the jambs and iron door. Ordinary brass screws, 1¾ inches long, will hold the hinges to the wooden door.

The glass over the transom of each door will be contained in a cast iron frame, secured to the jambs and lintel with nine (9) tap-screws $^3/_8$ of an inch diameter, having countersunk heads. The glass will be thick plate, well bedded upon putty, and held in the rebate by a sufficient number of pins, $^1/_8$ inch diameter, for which the frame will be drilled. The Frame for transom light, Fig. 10. Transom glass.

joint at the edge will then be thoroughly closed with putty in the ordinary manner. The frame to be cast true, and fit neatly in its place.

Inner lintel, Fig. 11. Curved flanges.

The inner lintel to be 5 feet 6inches long, 1 inch thick, and 2 feet wide at the narrowest part. Along each side there will be a flange, 9 inches high and 1 inch thick; the face of the one nearest to the axis of tower to be curved, with a radius of 5 feet 9 inches.

Flanges and ribs.

The end flanges to be 2 inches high and ¾ of an inch thick. Lintel to be strengthened lengthwise by one rib 8 inches from the nearest point of the curved flange. This rib to be 5½ inches high and ¾ of an inch think, stopping against the end flanges. Each lintel will have, also, a central rib ¾ inch thick and 5 inches high, running crosswise.

Cross ribs.

Outer lintel, Fig. 12.

The outer lintel to be 5 feet 6 inches long by three feet wide and one inch thick, strengthened by two (2) parallel ribs, 5½ inches high and ¾ inch thick, cast on the upper surface, running lengthwise, one on each side of, and 4½ inches from, the longitudinal centre line of lintel.

Ribs and flanges.

These ribs stop against end flanges 2 inches high. Along each side of the lintel there will be a flange 9 inches high and 1 inch thick, stiffened in the middle and at the ends by webs, which join the 2-inch flanges that extend across the plate.

Extra thickness.

If the head moulding of the transom light be cast separately for bolting on, an extra thickness, corresponding with the width and length of moulding, must be left on the under side of lintels, for planning down to a true surface.

Transom rail, Fig. 13.

The transom rail to have a general thickness of $^{3}/_{8}$ inch, cast hollow and open at the back; the end flanges to be ¾ of an inch thick, and secured to the jambs with wrought iron bolts and nuts, ¾ inch diameter.

Outer sill, Fig. 14.

The sill for the outer door to be $7^{3}/_{8}$ inches wide on the tread, $^{3}/_{8}$ inch thick at the outer edge, and $^{5}/_{8}$ inch at the inner, sloping ¼ of an inch.

Anchor, Fig. 17.

It will be stiffened underneath the middle by a triangular flange and a boss, through the depth of which latter a hole will be drilled for a $^{5}/_{8}$-inch bolt, having a countersunk head on the surface of sill; the lower end of bolt to be secured by a nut to a wrought iron eye, leaded into the edge of the granite door-sill below. (See U, Figs. 4 and 17.)

Inner sill, Fig. 15.

The sill for the wooden door to be 7¼ inches wide. It will have a uniform thickness of ½ inch. The edges will have flanges $^{5}/_{8}$ inch thick, dropping down $^{5}/_{8}$ of an inch form the under surface of the sill, to form a good joint with the floor tiling.

Enter the walls.

Both sills will extend 4 inches into the walls each side of the passage, with suitable flanges, to which the lower ends of the jambs will be bolted.

Diamond checkering.

The upper surface of each sill will be checkered to the depth of $^{3}/_{32}$ of an inch.

Moulding for head-light, Fig. 16.

The moulding over the head of transom light is shown upon the drawing as a separate casting, to be secured to the under side of lintel with three bolts and nuts, $^{5}/_{8}$ inch diameter, having countersunk heads; but if it will be more convenient, this moulding may be cast upon the lintel, the latter being channeled out on the upper surface, to preserve its general thickness over the moulding. Allowance must be made for neat fitting at its mitre with the jambs.

Wooden Doors.—Figs. 5, 6, 7, and 9.

The inner vestibule doors must be substantially constructed, in accordance with the drawings, of the best white pine sash stuff, $1^{7}/_{8}$ inch thick, thoroughly seasoned; the joints to be well plied with white lead, wedged and pinned.

Hinges.

Each fold to be hung with three pairs of bronze hinges, secured to the door with brass screws, and to the jambs with wrought-iron tap screws.

Mortise lock, &c.

A suitable brass mortise lock, keys, &c., with porcelain knobs, must be provided and fitted.

Door bolts.

Plate bolts at head and foot of wooden doors to be of brass.

Glass.

The glass substituted for the middle and upper panels of the doors must be of thick plate, properly bedded in their rebates, and held by the inner mouldings screwed firmly against their margin with a strip of thin rubber or a film of putty between.

Parapet door, Figs. 7, 8, and 9.

The wooden door of parapet is described under Plate No. 14.

PLATE NO. 6.

Oil Tank.—Figs. 1 to 8.

Dimensions.

The outside dimensions of the cast-iron oil tanks are 3½ feet long, 3½ feet wide, and 4 feet deep.

Cross Ribs.

The sides are $^{3}/_{8}$ of an inch thick, strengthened on the inside by horizontal and perpendicular ribs $^{3}/_{8}$ of an inch thick, 2 inches wide, crossing in the middle of each side.

Top.

The top (also $^{3}/_{8}$ inch thick) is strengthened outside by diagonal ribs tapering down from the flange of the cover to the corners of the tank. All the corners are additionally strengthened on the inside by triangular webs tying the top, bottom, and sides together.

Bottom.

The bottom of the tank is ½ inch thick, and slopes from each side towards the middle, meeting the triangular part, which also slopes form the back to the outlet in front.

Three (3) ribs, 10¼ inches from centre to centre, strengthen the bottom underneath. These ribs will run from side to side, being level for about 10 inches from each side, for the purpose of resting squarely upon the brick stools to be built at the side of each oil recess. Under the front and back there will also be flanges about 10 inches long, serving as feet. Ribs and feet, Fig. 4.

The three ribs will be made somewhat deeper in the middle, as shown at Fig. 4.

The hinges lid of tank, shown in enlarged detail, has an extreme diameter of 15 inches, covering a 12-inch circular opening; the surrounding flange of which is 1½ inches high, and has a dovetail groove for containing a ring of thick India rubber, upon which the lid closes for excluding the air, and is held by a spring catching over the front edge. Tank cover, Fig. 5. Spring catch.

The oil outlet is drawn in enlarged section at Fig. 6, which, with Figs. 7 and 8, show the brass air and oil cocks, and the key for the latter. Oil and air cocks, Figs., 6, 7, and 8.

These cocks will be furnished by the Light House Board, all finishes, ready for use.

The holes for them in the tanks to be tapped for the screws, the threads of which are standards of the dimensions marked.

The brick benches on which the oil tanks will rest are to be coped with a plate of ¼-inch boiler iron, 10 inches wide, running the hole length of the bench, (5 feet,) entering the wall 4 inches at the back of the recess, and turning down with a flange at the front. Bench for oil tanks.

The Weight for Revolving Apparatus.

This weight is composed of leaden disks of the form and dimensions shown at Fig. 13. There will be a sufficient number of them to make an aggregate of fourteen hundred (1,400) pounds. Revolving weight, Figs. 9 to 14.

The cast-iron plate keyed to the lower end of the 1-inch rod, will be dished out with a circular recess to the depth of ¼ of an inch, for receiving a corresponding projection on the under side of the lower disk, which, with all those above it, is recessed on its upper side, to accommodate similar projections and prevent displacement. Fig. 14.

The weight is suspended at the casting between the watch-room floor beams by a suitable hempen cord, (not shown on the drawings,) ½ inch diameter, passing under the cast-iron pulley, (Fig. 9,) the pin of which goes through the upper eye of a link on each side. Each link is of bar iron 1½ inches wide by $^3/_8$ inch thick, with another eye forged on its lower end, form which hangs a rod of ½-inch round iron one hundred and forty (140) feet long, and in sections of fourteen (14) feet each, connected by forged jaws and pins, the latter to be secured in their places by "lock nuts," or small pins driven through the end opposite the head. Weight-cord. Pulley. Side links. Suspending rod in sections, Fig. 10. Joints.

The eye-bolt on which the traversing pulley revolves is shown upon and described under Plate No. 10, Fig. 12. Pulley-bolts.

The bolt through the lower eyes of the links is shown with ordinary head and nut but it will be provided with a very thin head on one end and a pin driven through the other, in order that it may pass through the ring which steadies the lower ends of the guide rods.

Steps for Oil Recesses.—Figs. 15, 16 and 17.

The risers of the steps to the oil recesses will be built of brick to a height sufficient to bring the surface of the cast-iron treads of the first-oil recess flush with the surface of the two lowest steps of the first flight of tower stairs, and the surface of the single tread of recess No. 2 flush with the 9th tread of the same flight. (See Plate No. 7, Fig. 3.) The ends of these recess treads to be built 2 inches in the side walls, and the nosings to be mitred with the nosings of the adjacent steps. Risers and treads.

Well Curb and Railing.—Figs. 18 and 19.

When the cord is entirely unwound, the weight will disappear within the well in the floor of tower. Weight to enter the well.

The mouth of this well is surrounded by a cast-iron curb and a circular guard, the hand-rail of which will be of gas pipe, 2 inches outside diameter, supported by wrought-iron balusters ¾ inch diameter, secured to the upper flange of curb by collars above, and ¾-inch nuts and washers underneath. Conical curbing and rail. Balusters.

The curb is ½ thick, and cast conical to prevent its being withdrawn from the masonry of the foundation, which will be laid in close contact with the iron.

The flanges will be 1 inch thick; the lower one resting upon the floor tiling. Flanges.

The upper flange is 3 feet 3 inches diameter.

PLATE NO. 7.

Main Stairway.

The treads and risers, the wall castings, hand-rails and the balusters, are common to all flights, except the enclosed flight leading directly to the watch room. This flight, which is about half the height of the others, has no hand-rail. Treads, risers, &c., common to all the flights.

1st Flight, Figs.1 to 4.

Radius of stairway.

The first flight represented on this plate (together with each of the six flights above it) comprises one revolution of the circle, starting and stopping upon a radial line at ninety degrees (90°) from the centre line of entrance passage. The extreme radius of stairs is 5 feet 8 ½ inches, leaving a space of ½ inch between the edge of the steps and the cylindrical wall.

Number of steps, landing, &c.

Number of flights.

Areas of the treads.

The entire ascent from the tower floor to the watch room floor comprises 248 steps, including nine landings, with which latter the watch room floor will be numbered. These landings divide the height as follows, viz: seven flights 20 feet ¼ of an inch in height, embracing 31 risers each; one flight 10 feet 4 inches height, of 16 risers; and one flight at top, 9 feet 8¼ inches high, of 15 risers; the treads are always one less than the number of risers. In the topmost of enclosed flight, (see Plate No. 11,) each tread comprises an arc of 10½ degrees of the circle, measuring from the front edges of the successive nosing, which are in all cases radial lines.

Open flights.

The treads of all the lower flights are of 12 degrees each, measured in the same manner.

Rise of steps.

Step castings, Figs. 5 to 13 and Fig. 24.

The rise of the steps throughout will be uniformly 7¾ inches; the risers to have a thickness of $^3/_8$ of an inch. (See Figs. 9 and 13.) Each step will comprise three (3) separate castings.

Balusters turned.

Surface of contact finished.

The open riser and the spandrel next to axis of tower with their sleeve and boss (Fig. 10) to be cast in one piece, and secured between the adjacent treads by a ¾-inch nut on the lower end of the baluster, which will be turned to fit tightly in the hole through the sleeve and boss; the latter to be reamed out smoothly. The surface of the contact of the sleeves and bosses must be planed with shoulders, as shown at Figs. 10 and 24, to take the thrust of the stairs and give a solid bearing.

Thickness of treads.

The treads to be of a general thickness of ½ inch, roughened with diamond checkering to the depth of above $^3/_{32}$ of an inch. The back of tread to be thickened with a narrow raised border, which will also run along the outer curved edge, and form washers to accommodate the countersunk heads of the two ½-inch screw bolts securing the treads to the other spandrel.

Carrier flanges.

This outer spandrel will have a curved flange $^5/_8$ inch thick, dropping down 5 inches, normal to the spiral, and secured by ¾-inch wrought-iron bolts and nuts to a wrought-iron string or carrier. (See Plate 8, Figs. 1 to 5.)

Smooth castings.

These flanges must be cast quite smooth, and fit closely against the outer surface of the carriers.

Foot-Plate.—Figs. 14, 15, and 16.

The cast-iron foot-plate serves as a start for the first flight, and forms a base for the newel-post. It is bedded upon the stone E, (see Plate No. 3, Fig. 5,) and has its outer end built 2 inches in the wall.

Finished surfaces.

The circular projections forming the steps for newel are to be turned and faced to the exact dimensions marked, and the four holes to be drilled for ¾-inch bolts and nuts, which are to be provided and turned to fit tightly.

Size of bolts and nuts.

Length of body of bolts, 3 inches clear of the head, thread cut down 1¼ inch from the end.

A nut for the ¾-inch screw on the end of the lowest baluster to be furnished and firmly fastened in the square recess under the plate.

The stone to be cut out to accommodate any projections upon the under side of the foot-plate.

Wall Castings.—Figs. 17, 18, and 19, and Plate No. 8, Figs. 7 to 14.

The stringers will be firmly attached to suitable castings, which will be built in the brickwork of the stair well, (see vertical section of brickwork, Plate 2,) at heights coinciding with the spiral carriers. The latter to be secured by three wrought-iron bolts, 1 inch diameter, tapped into each casting; these tap-bolts passing through the flange of the spandrel at the points indicated. The included surface on the triangular face of the castings will project from the wall $1^3/_8$ inch towards the axis of tower; the face of these projections to be swept horizontally with a radius of 5 feet $7^5/_8$ inches, or they also may be provided with chipping pieces, to insure perfect fitting.

These castings will be placed 90 degrees apart.

Radius of flanges and stringers.

The toughing surfaces of the flanges and stringers must be swept horizontally with a radius of 5 feet 7 inches.

All the bolts for the wall castings must be provided, but the holes will not be drilled until their position may be marked through the carriers when the stairs shall be erected at the light-house.

Single castings.

Chipping pieces allowed.

NOTE.—The treads, risers, and other spandrels and flanges of the steps are represented on the drawing and hereinbefore described as separate pieces; but if any advantage may be derived from connecting the several parts of the step, they may all be cast in one piece, and if any difficulty is apt to be met in obtaining a through contact between the spandrel flanges and carriers, shallow chipping-pieces will be allowed for fitting.

Newel Post.—Figs. 20 to 23.

The flange on the bottom of the newel must be drilled for the bolts, and turned and bored exactly to fit the projections on the foot-plate. Bottom flange.

The ball on top of the post to be drilled and tapped for the 1¼-inch screw on the end of hand-rail, (Fig. 21.)

Stair-Rail.—Figs. 1 to 4, and Plate No. 8, Figs. 30 to 33.

The hand-rail for each flight of the spiral stairs will be formed of wrought-iron gas-pipe, 2 inches outside diameter, put together in two sections, of about eleven feet each, by inserting at the joints pieces of round bar iron, drilled for rivets, which will pass through it and countersunk on the outside of the rail. Joints.

The rail will be continuous throughout the height of tower, running straight along the edge of each landing.

In plan, the radius of the centre line of rail is 2 feet 11½ inches. At each step there will be a wrought-iron baluster, ¾ inch diameter, the upper end reduced to $^3/_8$ of an inch diameter, and bent at right angles with the hand-rail, through which it will pass and rivet. The axis of each baluster and the centre line of the rail will intersect at the uniform height of 2 feet 6 inches above the general surface of each tread. Radius of rail. Balusters, Figs. 24, 25, and 26.

The lower end of each baluster to have a fixed collar, 1¾-inch diameter and $^5/_8$ inch thick, to rest on the ¼-inch washer cast on the surface of each step. Below this collar the baluster will continue through the sleeve and boss of the adjoining parts of the steps, and be secured underneath with a suitable wrought-iron nut and washer. Lower ends. Washers.

The balusters along the edge of the landings will be of the same diameter as the stair balusters, with similar collars and riveted upper ends. The lower ends to pass through the flange of the 12-inch rolled beam, and be secured by a nut of sufficient thickness to allow beveling; or else a bevel washer (no shown) must be provided under the flange. Landing balusters, Fig. 25. Bevel nuts or washers.

At oil recess No. 3, the edge of the tower stairs is guarded by two curved rails of 1½ inch by ½-inch bar iron, inclining parallel with the bridge castings, the ends bent and built into the brickwork. (See Fig. 3.)

Each flight of steps to be temporarily fitted together at the workshop, and each piece must be marked or numbered with a chisel or letter-punch, to indicate its position when about to be finally erected at the light-house. Stairs all temporarily erected.

NOTE.—For the details of the well curbing shown in the elevation of stairs, see Plate No. 6, Figs. 18 and 19, and the description thereof. Well curb.

PLATE NO. 8

Stair-Stringers, Landings, &c.

The stair-stringer for each flight will be of wrought-iron bars, 1 inch thick by 5 inches wide, made in four sections, with scarf-joints 1 foot 10 inches long, strongly riveted. Stringers, Figs. 1 to 8. Scarfs.

The stringers will ascend in a cylindrical spiral, curving with an inside radius of 5 feet 6 inches.

The ends of the stringers will attach to the landing beams by a palm of plate iron, ¾ inch thick, one on each side of the stringer. As the outer palm is to be built partly in the wall, it may be permanently riveted, instead of bolted to the beam. Attachment to beams.

The bolts to be $^5/_8$ inch diameter, and provided with suitable nuts and washers; if rivets be used, they will be $^5/_8$ inch diameter. It will be observed that the palm is placed on the outside of the spandrel flanges of the top and bottom step. (See Figs. 15, 16, 21, 22, 23, 27, 28, 29.) Bolts and rivets

The position of the middle bolt, A, will fix the starting point in erecting the first flight. The centre of the bolt will be 8 inches above the surface of the floor and 108 degrees from, and on the left of, the axis of the passage, in entering the stairs. Bolt "A," Figs. 1 and 9. Position.

Figs. 6 and 7 are enlarged sections of the scarf of stringer, showing its attachment to the wall-castings.

Bridge-Casting.—Figs. 10 to 14.

The first flight will be supported at oil-recess No. 2 by an inclined bridge-casting, the ends being built into the walls. Curved face.

The face of the projecting curved portion at the middle to be swept with a radius of 5 feet $7^5/_8$ inches, the bridge being first fixed in the position shown at Fig. 11. This curved face to be cast smooth and true, for its close contact with the stair-stringer which fits against it, but the casting will not be drilled for the bolts till the stairs are finally placed in position.

Landing Details.—Figs. 15 to 29.

The edge of each semicircular landing is finished with a moulded casting, secured to

the floor-beam by the balusters of the railing. (See Figs. 28 and 29, and Plate No. 7, Fig. 25.)

At the head and foot of each flight a checkered plate will be fastened to the beam, as shown in plan, Fig. 29.

Brackets.

To support these plates, there will be brackets underneath, bolted to the beam, as represented in detail at Figs. 17 to 28.

For the construction of the handrail at the edge of the landings, see Figs. 30 to 33.

Wrought-Iron Beams.

Rolled beams.

The arches of each landing are supported upon rolled wrought-iron beams, similar to those manufactured by the Phoenix Iron Company, of Philadelphia.

12-inch beams.
9-inch beams.

The beams next to the axis of tower to be 12 inches deep, flanges 4 inches wide, and web ½ inch thick. Those between the arches to be 9 inches deep, with flange 3½ inches width, and a web of $^3/_8$ of an inch thick. The positions of these beams are shown in the horizontal sections on Plate No. 2 and on Plate 7, Fig. 4.

Number and length of beams.

The number of beams and their length are as follows: None 12-inch beams, 13 feet long; one 12-inch beam, 13 feet 6 inches long; seven 9-inch beams, 11 feet 6 inches long.

Service-floor beams.

The beam 13 feet 6 inches long is for supporting the cast-iron floor-plate of the service-room, (see Section **R S.** Plate No. 2, and Plate No. 10, Figs. 4, 5, and 6,) and is to be bolted to the lugs on the feet of two of the main gallery brackets. (See Plate No. 11, Figs. 5 and 15 to 17, also Plate No. 15, Figs. 3 and 8.)

Watch-room floor beams.

Two of the 12-inch beams support watch-room floor and the lens apparatus. (See Section **T U,** Plate No. 2, and Plate No. 10, Figs. 1, 2, and 3.)

The beams of all the arched landings will rest upon the cast-iron shoe-plates shown at Fig. 8, Plate No. 10.

PLATE NO. 9

Tower Windows.

Number.

The windows represented upon this plate belong to the shaft of tower, and are seven (7) in number, one placed at each landing. The windows between the main gallery brackets for lighting the service room will be described under Plate No. 15.

Separate castings.
Jambs, Figs. 11, 12, and 13.
Flanges planed.
Bolts.

The sills, lintels and jambs to be cast separately, the latter to be of a general thickness of $^3/_8$ of an inch, and provided with side-flanges for building into the wall. The rebates inside of the frame to be planed out to receive the sash, and the rubbing surface of the hinges to be finished smooth. The top and bottom flanges of jambs must be planed, to form perfect contact with the lintels and sills, to each of which the jambs are secured by two bolts $^5/_8$ inch diameter, provided with suitable nuts; thickness of flanges above and below to be 1 inch.

Glass.

Each window to contain eight lights of glass, 12 inches by 18 inches.

Sash, Figs. 1 to 8 and Plate No. 13, Figs. 15 to 24.
Steel pins.

The iron sash to be cast in two parts, meeting vertically in the centre, and hinges to open outward. All surfaces of contact must be planed to form a neat fit, and the hinges to be drilled with holes $^3/_8$ inch diameter for steel pins. Enlarged sections of sash details are shown on Plate No. 13, Figs. 15 to 24.

Cooling of sash castings.

NOTE.—The sash-castings must cool gradually, either in the flask or with the hot sand by which they must be covered, of removed from the flask before becoming cold.

Latches.

The sash must be fitted with inside latches of brass at the bottom, and also provided with catches of wrought iron on the outside, for holding them when open. (Plate 13, Figs. 18, 19, 24.)

Sills, Figs. 9 and 10.

The sills are to be of cast iron, of the form and dimensions shows. The inside to have a moulded apron 6½ inches deep against the brickwork. Outside sill to be plain, 4½ inches deep, straight across, and projecting about two inches from the curve of the wall at the nearest point. Outside of the sash a vertical projection at each side of sill will rise form the sloping surface to form a level bed for the brickwork of the window jambs. The thickness of the plate will be uniformly $^3/_8$ of an inch, except under the jambs, where the metal will be $^5/_8$ inch. The surface in contact with the flanges of window frame must be planed and form a tight joint.

Thickness.
Joints.

Lintels.—Figs. 21 to 25.

Similar castings.

The lintels of six of the windows will be alike, as shown at Figs. 21 and 22; but that for the seventh or the topmost window of the shaft, (Figs. 23 and 25,) will be a separate casting, and when in place its under surface will coincide with the lower edge of the frieze of the cast-iron necking or belt-course of the shaft. The sill of this window being only 1 foot 3 inches above the floor, a bar of 2 inches by ½ inch will be built into the jambs, to serve as a guard. (See Fig. 7.)

Window-guard in Fig. 7.

The pedimented window heads are represented as cast in one piece; but if it will materially facilitate the work, the head may be cast in several pieces, provided these various parts securely bolted together with perfectly tight joints, the metal flanges being thickened up where the contact takes place. Outside window heads, Figs. 26, 29.

The bolts must be ½-inch diameter, with countersunk heads on the outside. No wrought-iron strips shall be used, but suitable flanges must be provided where the bolting may require it. Bolts.

All joints exposed to the weather to be made with red lead or other good cement.

To the under side of each lintel there will be attached a rebated moulding, which will mitre with the cast-iron jamb pieces, and form the upper part of the frame. The surfaces of contact and the rebates must be planed, and the moulding will be drilled for three screw-bolts, ½ inch diameter, with countersunk heads underneath. Rebate for head of sash, Figs. 14, 15, and 16.

The consoles of brackets for supporting the window heads will be of cast iron, and have a general thickness of $^3/_8$ of an inch. The plate extends inward the whole depth of the window-jamb, and its surface will be flush with the brickwork. These plates will have flanges on the inner edge, and be bolted to the jambs. All bolt-holes to be drilled, and the surfaces of contact of the joints exposed to the weather must be planed and rendered water-tight. Window brackets, Figs. 17 to 20. Connection with jambs.

PLATE NO. 10.

Watch-Room Floor, &c.—Figs. 1, 2, and 3.

The extreme diameter of the watch-room floor will be 12 feet 5½ inches, composed of three (3) cast iron segments, the adjoining edges of which will be fitted together with planed oil-tight lap-joints, ¾ of an inch deep and ½ an inch wide, secured with wrought-iron bolts and nuts, 1 inch diameter, passing through flanges 1 inch thick, projecting down from the under side of the plates. Diameter. Lap joints, Sections BB and DD. Flanges and bolts.

The general thickness of the floor will be 1 inch. Around the periphery which rests upon main brackets the thickness will be increased to 1¼ inch, and the plate must have a solid bearing the whole length of the beams, the thickness being increased at these places also. Thickness and checkering.

The segment at the head of the stairs will comprise 78 degrees of the circle, and the middle segment ninety degrees; the arc of the remaining segment, forming the back edge of the stair opening, is not marked, as this edge is not a radial line, but it is drawing so that its moulded flange at the corner nearest the axis of the tower shall clear the flange of the floor beam, giving sufficient space for the foot of the outer carrier of lantern stairs. Chipping-pieces and lugs will be cast on the floor to receive the feet of the carriers. Arcs of segments. Back of stair opening. Lantern stair lugs.

In like manner with the steps and landing-plates, the upper surface of the floor will be roughened with diamond checkering bounded by a plain border ½ inch wide on each segment at the joint, and a gutter 2 inches wide and ¼ inch deep skirting the wall. Checkering. Borders and gutter.

The periphery of the floor is to be built in the wall, where it is made 1¼ inch thick by a plain border of 5¾ inches width, outside of gutter on top, and 8 inches width underneath. Edge built in the wall.

On Plate No. 11, Figs. 19 and 20, the bracket-shelf for watch-room floor beam is lettered D, and on Plate No. 15, Figs. 1 and 10, lettered D'. Bracket shelves.

In the centre of the floor there will be an opening, 2 feet 3½ inches square, surrounded by a chipping-piece 1 inch wide, to finish at least ¼ of an inch high, but it must be cast high enough to permit any chipping required for leveling the base of the lens column. Opening under lens column.

At the joint, on each segment, there will be a plain border ½ inch wide, against which the checkering will stop.

At the head of the enclosed stairs, on the edge of the floor plate, there will be cast a solid riser, $^3/_8$ of an inch thick, dropping down and bolting to the front of the flange on the back of the step next below. This riser will be strengthened at the back by two curved webs. Solid riser.

Underneath the floor, near the circular edge of the stair opening, there will drop a flange 1¼-inch thick, which will be drilled for the ½-inch bolts suspending the plate-iron casing of the stairs. These bolts are placed one between every two (2) of the bosses through which the railing standards pass. These bosses are formed by swelling out the flange towards axis of tower, and drilling them with ¾-inch holes for the standards. The bosses at each end of railing will be drilled with 1¼ inch holes. Flange for stair-casing. Railing bosses.

The outer face of the flange against which the casing is bolted will curve with a radius of 2 feet 8¾ inches; one of the floor beams will break its continuity. On reaching the line midway between the floor beams, the curved flange will turn and form a flange running parallel with the beams and terminating against the wall, at which point, as well as at the junction of the curved and straight flanges, recesses will be formed for the door frame. (See also Plate No. 11.) Radius of flange. Flange over door. Recesses for door-frame.

On the underside of the middle segment of floor, there will be a flange 1 inch thick and 4½ inches deep at the beam, tapering to 2 inches at the walls. This flange is at right Strengthening flange.

angles to the beam, and stops within ½ an inch of the latter, where the flange divides into two (2) cheeks, between which the web of a cast-iron bracket will be secured with four (4) bolts and buts ½-inch diameter. The palm of the bracket will be held to the web of the beam by three (3) bolts $^5/_8$ inch diameter. A bracket of the same pattern will be bolted to the opposite beam, the web of bracket being held between the flanges at the short joint, which runs from the beam to the curved edge of stair opening. The floor plates are likewise held down to the flanges of the beams by ¾-inch bolts, the heads of which will be countersunk in the border which separates the checkering from the chipping-piece surrounding the central square opening in the floor.

Floor brackets, Fig. 11.

Floor bolted to beams.

At the surface of floor a space of 1 foot 11½ inches will be prepared with chipping pieces for receiving the base of the clock-work pedestal, (Plate No. 16, Figs. 16 to 19.) An opening 3 inches wide by 12 inches long will be in the floor to allow the weight cord to pass down to the curved barrel. A flange ½ inch thick and ½ inch high, will be raised around this opening.

Aperture for weight cord.

At the edge of plate directly opposite the stair opening, chipping pieces will be provided, conforming with the shape of the parapet door-sill and the base block of each jamb.

Parapet door sill.

Floor of Service Room.—Figs. 4, 5, and 6.

The semicircular landing forming the floor of the service room will be cast in two (2) quadrants, having an oil-tight joint, fitted similarly to those of the watch-room floor, and its surface will checkered in like manner with the latter, having a similar channel or gutter at the wall, and the plain border at the joint.

Joint.

The outer edge will rest upon and be bolted to the shelves near the feet of the main gallery brackets. The shelf is shown on Plate No. 11, Figs. 15, 16, and 17, and lettered C. On Plate No. 15, Fig. 1, this shelf is lettered C'.

Bracket shelves.

The general thickness of the floor will be 1 inch, but increased to 1¼ inch thick at the curved edge, and where it rests upon the bream.

Thickness.

At the head of the flight ascending to this floor, the plate will be reduced to one-half (1/2) an inch in thickness, and the riser attaching below can be cast from the pattern used for those of the stairs.

Riser.

The railing along the edges of the floor will fasten to the beam, as has been described under Plate No. 8.

Railing.

The rail terminates against the door frame of the enclosed stairway.

On the surface of floor, at the foot of this stairway, there will be flanges ¾ of an inch thick, raised 5 inches high, to which the feet of the door frame will be secured. The heads of the bolts will all be countersunk.

Flanges for door-frame.

Along the edge of the floor, at the stairs, a flange ½ inch thick and 2 inches high, will be cast on, and the bottom of the solid riser of first step be secured to it.

Step flange.

The diametrical edge of floor will have a moulding similar to that on the castings for the arched landings.

A small bracket like those which attach under the watch-room floor will be secured to the service floor and beam, the flanges at the joint of the segments opening to accommodate the flange of the bracket.

Floor bracket, Fig. 11.

Pulley Casting.—Fig. 7.

For supporting the barrel and pulley over which the weight-cord of the revolving apparatus passes a casting will be bolted between the beams of the watch-room floor.

In the cheeks between which the pulley revolves are two holes 1¼ inch diameter, to provide for a single or double purchase of the weight-cord. If the old lens and apparatus be used, the *double* will be necessary, and the wrought-iron pulley bolt will pass through the hole farthest from the journals of the curved barrel; but if the new lends and apparatus be adopted, only the single part of the cord will be required, and half of the revolving weight may be dispensed with.

Pulley bolt, Fig. 7½.
Provision for old and new lens.

The bosses through which the pulley and barrel pins pass, must be accurately bored and faced, and care must be observed to put the curved barrel in its place before the casting shall be bolted between the beams.

Journals.

The bolts will be 1 inch diameter, and fit tightly; one will go through the middle of each flange on the outside of the web which extends form beam to beam; and on the inside of said web there will be two (2) bolts near the upper and lower flanges of rolled beams, respectively.

Bolts to fit tightly.

The bolts which secure the floor brackets to the watch-room beams will also pass through the pulley casting, and aid in fastening it to the beams. These bolts to be $^5/_8$ inch diameter, and provided with suitable nuts and washers.

Shoes for Beams.—Fig. 8.

The ends of all the rolled beams which carry the arches of the landings below the

service-room floor are to rest upon plates of cast iron, 15 inches long and 6 inches wide, to spread their bearing upon the brickwork, and to be built in the walls.

The shoes for the 9-inch beams will be set at an angle of about 30 degrees with the beams, right and left, with the lugs inclined as shown.

Flange for Stair Casing.—Figs. 9 and 10.

For the purpose of supporting the outer casing of the enclosed stairs, a curved flanged casting, in two parts, will be bolted to the shelves on the heads of certain of the main gallery brackets, and afterwards built in the brickwork.

The flange which drops down against the face of the stair well will be drilled with ½-inch holes, at distances of 8 inches apart, and the bolts inserted form the back, but they and the horizontal flange should not be bricked in until the casing has been bolted to it. ½ inch bolts.

The upper surface of the casting is flush with that of the watch-rom floor, and near the nosing a gutter or channel will be sunken, similarly to that on the service and watch-room floors. Gutters, &c.

Guide-Rods, &c.—Figs. 12, 13 and 14.

For the combined purpose of guiding the traversing pulley, to prevent the twisting of the two parts of the weight-cord, and to check the fall of the pulley and the jointed rod which suspends the revolving weight, in case the cord should break, two rods of 1-inch round bar iron, will be attached by palms to the pulley-casting, on the outside of, and hooking over the upper edge of the cheeks, to the flange of which the palms will be secured by wrought-iron tap-screw ½ inch diameter. Palms.

The lower end of each guide-rod will be increased to $1^1/_8$ inch diameter, for a length of 6 ½ inches, upon which a coarse thread will be cut, and a hexagonal nut, 2 inches deep, will screw on here to receive the blow, should the pulley accidentally fall. Screw ends.

Between this nut and an upper one, ¾-inch thick, a yoke or ring of wrought iron 1½-inch by ½-inch, will be screwed for steadying the lower ends of guides. The yoke will be attached, by two $^5/_8$-inch bolts and nuts, to the underside of the beam of the landing next below the service room. Yoke, Fig. 14.

To prevent the thread from stripping, a split key, 2 inches by ¼-inch, of a slightly wedged shape, will be driven through the slot made for it in the screw ends, and the split parts spread, to prevent withdrawal. Split key.

The centre pin of the pulley is shown on Plate No. 6, Fig. 9, as an ordinary bolt, 1¼ inch diameter, but its head and nut will each be formed into an eye for sliding up and down upon guide-rods. This arrangement is fully shown in Plate No. 10, Figs. 12 and 13. Pulley bolt, Plate No. 19, Fig. 12.

The body of the guide-rods must be turned, the eyes of the pulley-bolt and nut drilled out, and the yoke smoothly forged.

PLATE NO. 11

Enclosed Stairway and Main Bracket Shelves.

To prevent injurious draughts of air reaching the lantern, the topmost flight of 15 steps will be cased in with curved plates of wrought iron, $^3/_{16}$ of an inch thick, shown in development at Figs. 6 and 7.

At the foot of the enclosed flight there will be a door, 7 feet high by 2 feet 5 inches wide, made of plate iron $^1/_8$ of an inch thick. Iron door, Figs. 1 and 3.

On the inside, the edges of the door will be battened with 2 inch by ½-inch bar iron; and on the outside with 2½ inches by ½-inch bars, the latter projecting ½ inch beyond the edges, forming a lap all round. The middle of the door will be stiffened on both sides by vertical and horizontal bars of 2 inches by ½ inch. All the bars to be secured with ¼-inch rivets, having rounded heads, inside and out. Battens, &c.

The foot of door will close against the nosing of the step, (left square for the purpose.) Three sets of bronze hinges are to be provided for the door, and properly secured to it and to the frame with $^3/_8$-inch rivets, or tap-screws. Hinges.

The outside door of parapet will be constructed according to the above description, but will be of different outside dimensions, and is shown on Plate No. 14, Figs. 7 to 10. Parapet iron door.

If, from the position of the lock, it shall be found inconvenient to open the door from the stairs, the inner knob must be replaced by a bell-crank handle, receiving its motion, by means of a light rod, from a similar handle placed, say 18 inches above the lock, where it may be reached from one or two steps above the foot. If necessary, extra springs must be provided to keep the bolt of the lock in position to catch easily. Lock and door handles. Springs.

The door frame will be constructed of angle and bar iron, riveted together to form rebates, and secured at top to the under side of watch-room floor, and at bottom by ¾-inch bolts, through flanges east on the floor of the service room. A flange will be turned on Door frame. Figs. 1 to 4.

the perpendicular edge of each curved casing, and riveted between the bars forming the door frame.

Transom light and frame.

To light the stairs, a plate of thick glass will be secured over the head of the door, by the strip of bar iron on the inside in which rebates will be planed.

Glass.

The glass to have a good bed of putty.

Rivets.

The rivets through the door frame to be $^3/_8$-inch diameter, with countersunk heads on the outside, except those through the hinges, which will have round heads, unless screws by used.

Step, Figs. 8 to 11.

Each step will have a closed riser $^3/_8$ inch thick, which will be secured by ½-inch bolts and nuts to a radial flange 2 inches high, cast on the back edge of each tread. (See Figs. 3, 5, and 13.)

Side flanges.

The treads will be checkered as shown, to the depth of $^3/_{32}$ of an inch.

Bolts.

The tread and riser will be connected at each end of step by a triangular flange, by which it will be secured to each plate with two wrought-iron bolts and nuts, ¾ of an inch diameter, which also pass through the strip of 3 inches by ¾-inch bar iron attached outside at the lower edge of each casing. (See Figs. 3, 4, 5, and 12.)

Plates of casings, Figs. 6 and 7.

Both casings will be composed of plates of convenient width; the vertical joints abutting and covered with battens of bar iron 2 inches by ½ inch, secured by rivets $^3/_8$ of an inch diameter. All the rivet heads to project, except those next to the axis of tower on the inner casing, which will be countersunk.

Rivets.

At the watch-room floor, the casings will turn with a flange at the back of the solid riser, to which the plates will be secured with three (3) bolts $^3/_8$ inch diameter, having their heads countersunk into the front of riser.

Bracket shelves, Figs. 15 to 20.

The shelves at the head and foot of the main gallery bracket, represented in enlarged detail on this plate, are shown also upon Plates No. 15, Figs., 1, 2, 5, 8, 10, and 12.

PLATE NO. 12.

Upper part of Tower.

"Capital."

In this plate are represented all the parts of the iron-work constituting the "capital" of the tower, including a portion of window No. 7.

Service-room window.

The window A, and ventilator of the service-room, does not, in this plate, occupy its proper position, being introduced only to show its connection with the other parts of the work.

Wall section.

The brick wall of watch-room is shown in section, which is taken beyond the flanges of the segments of the iron parapet, in order to give a view of the manner of securing the parapet and the floor-beams to the brackets.

Fall of revolving weight.

The weight-cord, and the end of the curved barrel and pulleys over which it passes, are represented with the lower pulley at about half its intended hoist, the whole height of which will be a little over 19 feet.

Size and quality of weight-cord.

The cord will be of hemp, about ½ inch diameter, best quality, very strong, and long enough to allow, when unwound, the weight to rest on the bottom of the well in the foundation of tower.

PLATE NO. 13.

Main Gallery and Watch-Room Railings, Window Sash, and Parapet Ladder.

Watch-room railing, Figs. 1, 2, and 3.

The railing around the edge of the stair-opening in the watch-room floor will be formed of a bar of 1½-inch round iron, curved with a radius of 2 feet 7½ inches, measuring to the centre line.

Balusters.

The rail will be elevated 3 feet above the floor, supported on nine (9) wrought-iron balusters, seven (7) of which will be ¾ of an inch diameter.

End standards heavier.

The two end standards will taper from 1¼ inches diameter at the base to ¾ of an inch at the rail. All these balusters will be reduced to $^3/_8$ inch diameter, and pass through the rail for riveting on the top with countersunk heads.

Riveting.

Fastening at the floor.

The shanks of the balusters will pass through the bosses cast on the under side of the floor-plates near the edge of stair-opening, and be secured with nuts for screws of the same diameter as the balusters measure just above the collars.

Rail bolted to lantern steps.

The end of the rail next to the lantern steps will double back with a radius of $5^3/_{16}$ inches, and be fastened to the inner carrier by means of a small palm drilled for the $^5/_8$-inch bolt which secures the back of the flange on the fourth step above the floor. (See also Plate 16, Fig. 14.)

Main Gallery Railing.—Figs. 4 to 9.

The railing around the edge of the main gallery will be formed of wrought-iron bars and cast-iron posts, each of the latter to be secured to the gallery by a wrought-iron bolt, 1¼ inch diameter, cast in the post, and passing down through the gallery plate and bracket boss.

The middle rail will be secured to the posts by bolts $^5/_8$ inch diameter, passing through the flanges of the two adjacent sections of rail, and provided with suitable nuts. This and the lower rail will be drilled with $^3/_8$-inch holes, and countersunk for riveting the reduced ends of the ½-inch perpendicular rods, forming the caging between the posts. Middle rail. Caging, Figs. 4, 5, and 7.

The posts can all be secured in their position, and the panels of caging sprung into place form the outside.

The flanges of the lower rail will be held in their recess by ½-inch bolts tapping into the base of the posts. (See Fig. 7, and Section **G G** of Fig. 4.)

The top rail will be a compound one of the cast-iron segments, riveted to wrought-iron bars, which latter will be scarfed at the posts, and drilled for a "T"-headed bolt, (marked L, Fig. 7,) $^5/_8$ inch diameter; the head to pass through a slot in the upper end of post, and be turned quarter way round for the head to catch. Top rail, Figs. 4, 6, and 7.

The rail will be secured to the post by cast-iron knobs, screwed on. Knobs.

The three wrought-iron rails will each be 2 inches wide by ¾ inch thick.

Parapet Ladder.—Figs. 10 to 14.

The outside gallery of the lantern is reached by a wrought-iron ladder, of eleven (11) treads or rounds, 10 $^5/_{16}$ inches apart.

The sides or stringers of the ladder to be 2-inches by ½-inch bar iron, 10 feet 6½ inches extreme length, the thickness of upper ends increased to 1 inch, and a slot 6½ inches long by 1 inch wide cut out to permit the ladder to slide upward, when raised for throwing its feet against the base of parapet. The upper end of ladder will be held in place by two wrought-iron pivots, forged with palms for bolting to the edge of gallery. Stringers. Pivots.

These pivots will be $^7/_8$ inch diameter, and each provided on the inside of ladder with a washer and ¾-inch nut, screwed against a shoulder, with a suitable washer between.

Each tread is formed of two pieces of ½-inch round iron, 18 inches long between the stringers, through which they will be reduced to $^{11}/_{32}$ inch diameter, with a shoulder, and firmly riveted on the outside. Rounds.

This ladder is shown on Plate No. 12, on the right of the parapet door, but it may be placed wherever most convenient. It is drawn directly in front of the railing standards, which will aid a person's ascent to the gallery. Position of ladder.

PLATE NO. 14.

Cast-Iron Parapet and Details.

The parapet is constructed of segments of cast-iron, $^5/_8$ of an inch thick, and 9 feet 5¾ inches extreme height from the joint at the main gallery to that at the lantern gallery. Segments, Figs. 1 to 5.

Each segment will have a base 11¾ inches high, and a frieze 10 inches in depth, including the width of their respective ogee mouldings. Base and frieze.

The outside radius of the base is 7 feet 3 inches, that of the frieze 7 feet 4 inches, and of the body 7 feet 2 inches. The chord outside of each segment is 2 feet $9^9/_{16}$ inches; at the body the chords of the base and frieze vary with their radii. Radii. Chords.

Fifteen (15) of the segments will be cast from the same pattern. The sixteenth segment is modified for the door-way leading out from the watch-room on to the main gallery. Number of segments. Doorway.

All the joints between the segments and the flanges in contact with the main and lantern galleries must be accurately planed and made perfectly weather-tight. Joints planed.

All the flanges are 1¼ inches thick; those at the side are secured together with wrought-iron bolts, $^7/_8$ of an inch diameter, provided with suitable nuts and washers. Flanges and bolts.

The bolts holding the parapet and the main and lantern galleries together are 1 inch diameter.

One bolt in each corner of the lower flange of parapet will pass through the flanges of both the main gallery and the bracket. The parapet is additionally held down to the brackets by plate-iron clasps. Clasps, Figs. 3 and 6, and Plate No. 15, Figs. 1, 3, and 10.

The upper part of the modified segment for the parapet doors will have the frieze and the top flange common to the other segments, as shown at Fig. 4, and will likewise have on the outside (see Figs. 9 to 13) and inch projection 6¼ inches deep, in imitation of a lintel, to join with the plain 6-inch architrave cast on the door-jambs, and lapping over the vertical joints of the adjoining segments. The face of this architrave is "flush" with the base of parapet, the ogee moulding of the same stopping against the jamb. Parapet door – head and frame.

The jambs are 6 feet 10½ inches high from bottom to top, ½ and inch thick, and cast with a shallow moulded panel. Jambs, Figs. 8, 9, 10, and 17.

On the outward part of jamb, flanges 3½ inches wide by 1¼ inches thick will be cast, for bolting to the corresponding vertical flanges on the adjoining parapet segments. Flanges.

The inside moulded architrave forms a part of the jamb castings, which must be made right and left.

The Section F F, (shown between Figs. 7 and 9,) is taken through the outer architrave of door-way, and shows the recesses into which the hinges will be sunk, the metal Hinge recess.

behind them being thickened for holding the rivets, (see also Fig. 21;) only one jamb to be recessed.

Sill, Fig. 15, &c.

Checkering

Sill bolts.

The sill will form a part of the casting which continues the base of parapet under the door. General thickness of the tread will be $^5/_8$ of an inch, and checkered to a depth of $^1/_8$ of an inch; the edges under the jambs to the sill, and are shown in Fig. 14, where the inner one is shown passing through the flange of the jamb, sill, floor, and bracket-flange. The outer one of these three bots should be reversed, the nut screwing up from underneath.

Lintel, Figs. 16, 18, and 19.

Rib.

The lintel of doorway will be a separate casting, with an inner moulded architrave to match those on the jambs. Its thickness will be ½ an inch, stiffened by a $^3/_8$-inch rib, 2½ inches high, running across from jamb to jamb, to prevent the lintel from springing when the brickwork shall be laid upon it.

Panel.

Bolts and nuts.

The under side of lintel plate will be sunken $^3/_8$ of an inch, with a moulded panel, similar to those in the jambs; the ends will be thickened to 1 inch, and be secured to the upper flanges of the jambs with 1 inch bolts and nuts.

Curved edge.

The outer edge of the lintel will be curved, and rest upon a horizontal flange, turning inward on the lower edge of the small frieze casting over the iron door. This flange will be tapped for the $^5/_8$-inch screws which secure the lintel to it.

Straight architrave.

The moulded architrave over the head of inner door will run straight across from jamb to jamb; while the inner wall will be curved, with a radius of 5 feet 9 inches.

Iron door of parapet, Figs. 7 to 10.

The outer door of parapet will be 2 feet wide by 6 feet 11½ inches high, constructed of plate and bar iron, in precisely the same manner as the door at the foot of enclosed stairs. (See Plate No. 11, Figs. 1 and 3).

The parapet door must be fitted with substantial brass lock, knobs, and keys, and provided on the outside with a suitable hook and eye, for retaining it when open.

Wooden Door of Watch-Room.—Figs. 7, 8, and 9.

The inner parapet door to be 2 feet extreme width, by 6 feet 11 inches high, and 2 inches thick, constructed in the most substantial manner, of the best white pine sash-stuff, thoroughly seasoned, the joints plied with white lead, wedged and pinned.

The bottom to have a “drip” ploughed near the outer edge, underneath.

Panel and lights.

Lower half of door to be paneled, the upper to be furnished with four lights of best quality glass, 8½ inches by 12½ inches, well bedded, and secured in the rebates by suitable battens, held firmly by brass screws, against a strip of thin gum, or a film of putty.

Hinges and screws.

Door to be hung with 3 pairs of suitable brass hinges and screws of the same metal, 1¾ inch long tap-screws wo hold the hinges to the jamb.

Lock.

Mortise-lock to be provided and fitted, and the pockets for the bolts of both floors to be chipped into the jambs.

Main entrance door.

For the wooden door at main entrance of tower, see Plate No. 5, Figs. 5, 6, 7, and 9, and description thereof.

PLATE NO. 15.

Main Gallery Plates, Brackets, Paneling, &c.

Brackets, Figs. 1 to 5, and Figs. 8 and 16.

The main outside gallery, at the top of the tower, is supported by sixteen (16) cast-iron brackets, of the form and dimensions indicated. Their bases rest on a good bed of cement 149 2¾ inches above the floor of the tower, at which height the wall will be about 2 feet 9 inches thick, and made perfectly level all around.

Tie bars, Figs. 3 and 11.

Bracket enclosed in the wall.

Bolts.

Gallery to slope.

The brackets are firmly connected together at the tops by ties of 4 inch by 1¼-inch bar iron, flanged and secured at each end to the web of the bracket, which will afterwards be built into the brickwork, together with all that part of the bracket towards the axis of tower within the inclined flange, the brickwork bonding through the openings between the 6-inch rails. The upper ties will be fastened with wrought-iron bolts and nuts, 1 inch diameter, two (2) bolts through each flanged end. The tapered strip upon the surface of the top flange of bracket is designed to give the gallery-plates an outward slope of 1½ inch and the short flanges raised on the edges of the portion over the brickwork from channels to carry off any leakage of the joints at that point.

Shelves.

The shelves C’ and D’, and the lug B’, correspond with those represented by the same letters on Plate No. 11, Figs. 15 to 20.

Shelf C only on six brackets.

Chipping-pieces.

The upper shelves D’. support the edge of the watch-room floor, and the flange to which the stair-casing attaches; the lower shelves C’, support the semicircular floor of the service-room, and will be required on only six (6) brackets. Chipping-pieces will be cast on the brackets under the gallery-plate flange on which the parapet sets.

Wedges, &c.

Small wedges and pieces of iron, of various thickness, to be furnished to bring surfaces to a level in refitting the work at the light-house.

Bracket bosses.

The bosses on the outer end of bracket will be cast hollow, having the thickness of ¾ of an inch; the upper and lower ends closed, with the exception of the hole, which will be reamed out to 1 ¼ inch diameter for the bolt, which secures the railing-post.

A cast iron-drop, (Fig. 14,) forms the nut by which the railing-bolt is secured underneath the boss of bracket. The object of the plate-iron clasps is to assist in holding down the cast-iron parapet. They are secured to the brackets by the 1-inch bolts which pass through the ties. At each side of parapet door there is but a single clasp 1 inch thick; all the others are doubled and ½ inch thick.

Nut, Fig. 14.

Wrought Iron clasps, Figs. 1, 3, and 10, and Plate No. 14, Figs 3 and 6.

When the brackets are in position, the radial distance of the centre of the railing-boss is 13 feet from the axis of tower.

Anchor Bolts.—Fig. 29.

The bracket-bolts, are 1¼-inch round iron, and sixteen (16) in number, forged in different lengths, viz: 6, 8, and 10 feet, in order that no two adjacent anchor-plates, except those at window No. 7, shall lie in the same horizontal plane. The proper number of each length of bolt is given upon the drawing, and they will be located as follows: the two which are bent will pass down, one on each side of tower window, (No. 7.) These are each 10 feet long, and going from them, either way around the circle, every third bolt must be 10 feet long; the others, 6 and 8 feet long, will alternate between them.

Number and length.

Arrangement of anchor bolts.

To fit the socket formed by the ribs crossing on the under side of the cast-iron anchor-plate, at the lower end of each bolt, there will be forged a large square head. The upper end will have a heavy thread, cut down 6 inches, and provided with a nut 2 inches deep and 2¾ inches diameter, across the sides.

Anchor plate, Fig. 20.

Screw ends of bolts.

In screwing up the bolts alongside the window, the tendency is to draw over the portion below the bend, and injure the brickwork; to prevent this, a spreader of 3 inches by 4 inches angle iron, must be provided and laid on the lintel of the window; the bolts at their lower bend closing into the notches on the ends of spreader.

Spreader, Fig. 7.

To counteract the tendency of these bolts to spread at the upper end, a tie of 4 inches by 1-inch bar iron, will be slipped over their upper ends before the brackets are placed in position.

Tie, Fig. 6.

Wooden Templet.

To enable the masons exactly to place the anchor-bolts, a substantial wooden templet, (or two if required,) accurately marked and bored, must be furnished by the contractor for the iron work, who must also provide the necessary nuts and washers or clamps for securing the templet at any height on the bolts, in advance of the ascending brickwork.

Nuts and washers or clamps.

The templet should be made in sections, strongly battened and bolted together, and marked, so that it may be correctly re-adjoined after being taken apart for transportation.

The inside edge should be of the same diameter as the stair-well, by which the work may be plumbed, and the bolts restored to their proper line, should they be inclined to spring.

The greatest care must be observed in setting the bolts, and bringing their upper ends in their proper positions, because no allowance has been made in the bolt holes for any subsequent shifting of the brackets.

Gallery Plates.—Figs. 9 and 15.

The main gallery is formed of sixteen (16) plates of cast iron. The radius of the outer edge of plate is 14 feet, and will project $^5/_8$ of an inch beyond the face of a $^5/_8$-inch flange, which drops down 2 inches to receive the ½-inch wrought-iron bolts by which the cornice moulding is secured.

Extreme radius.

The radial edges of the plates will be planed to form tight joints. The upper surface of parapet-flange to be planed, and the circular projections of the bosses of the posts of gallery-railing to be turned to the neat dimensions marked, to enter the bases of the posts.

Surfaces of cont et planed.

The under side of each plate will be strengthened by a rib, 1 inch thick, 3 inches greatest depth with the edge curved as shown in the Sections **G G**, Fig. 9.

Ribs.

Fig. 16 shows the attachment of the plate to the bracket; plain surfaces, flush with the points of the diamonds, being left in the checkering at the joints for countersinking the heads of the 5/8-inch bolts.

Plates bolted to brackets.

The length of the diamonds will be 1 ¼ inch and 1/8 of an inch deep, the “valleys” between them, running at angles of 30 and 60 degrees from a radial line, bisecting the outer curved edge of each plate. There will be a plain border, of 6 ½ inches width at the outer edge, and another of 1 ½ inch width at the root of the parapet flange.

Checkering.

Plain margins.

The curved flange, on the under side of plate near the narrower end, will drop down 2½ inches, to receive the bolts which secure the upper end of the panels between the brackets.

Panel flange.

The cornice for the edge of gallery is shown in vertical section at Fig. 17, with the manner of attaching it to the plates and to the brackets.

Cornice, Figs. 9 and 17.

The bolts securing the cornice to the lug on the bracket boss will be ½ inch diameter, and have countersunk heads outside.

Thickness of brackets.

Thickness of the part of bracket built in the brickwork, 1 inch; the web and flanges below the lattice, ¾ of an inch. (See Sections, Fig. 16.)

Bracket Panels.—Figs. 13 to 21.

From the under side of the gallery down to the belt course, the tower is encased with cast-iron panels, bolted to the inside of the inclined flange of the brackets. (See, also Plate 12.)

Thickness, &c.

The general thickness of the metal is ½ inch, the edges increased to $^5/_8$ of an inch, and drilled for wrought-iron bolts $^5/_8$ of an inch in diameter, the heads of which will be countersunk on the outside of the bracket flange. If the surface of contact between the bracket flanges and panels can be cast true enough to form a good joint, they need not be planed, but in any case they must be thoroughly plied with red lead, or other cement as durable.

Cement joints.

Connection with belt course.

The horizontal flange on the bottom of panel to be 1 inch thick, frilled for five (5) bolts 1 inch diameter, by which it is secured to the belt-course flange; surface of contact to be planed and cemented.

Lattice.

The lattice in the upper end of panels is for the purpose of letting in the air to the ventilator, one of which latter, is placed over each of the three windows of the service-room.

All the other panels will likewise contain this lattice, but the brick will be laid up close behind it.

The lattice will be vertical, while all the panel below it will be inclined with the flange of the bracket.

Straight panels.

The sunken portion with its margin will be, in horizontal section, straight, and parallel with a chord of the arc of the segment or panel; but the lattice, and the lower edge and flange below the moulded recess, will be curved horizontally with the radii marked.

Service-Room Windows.—Figs. 18, 21, 22, 23, 24, and Plate No. 12, Letter A.

The openings for the windows will be formed in three (3) of the bracket panels, by leaving out the portion shown by the dotted line in the elevation of Fig. 13.

Separate castings.

The sill, jambs, and lintel of each window are cast in separate pieces, and bolted together.

Thickness.

The general thickness of these castings will be $^3/_8$ of an inch, and the jambs and lintel will have a shallow panel sunk in them $^3/_8$ of an inch deep, finished with a half-round moulding about their edges.

Glass.

The glass to be opaque, in single panes, 4 feet high, 1 foot 6½ inches wide, and 1 inch thick; such as is used for floors.

Fig. 18 shows the rebate and glass stop, with its mitre and the screws.

The panel between the brackets (Fig. 12) being narrower at top than bottom, its edge, against which the window jamb is to be screwed, must be cast wedge-shaped, (thicker at top than bottom,) in order to bring the jambs into a perpendicular position.

Sill, Figs. 21 and 24.

The sill will be secured to the bracket panel with four wrought-iron screws, ½ inch diameter, tapping into the panel underneath the lower edge of the glass rebate.

Countersunk screws.

The screw-heads to be countersunk into the flange, which projects up $1^5/_8$ inch.

The inner edge of sill is curved concentrically with the tower wall; a moulded apron will drop down from this curved edge $3^5/_8$ inches. The sill must be well bedded in cement upon the brickwork under it.

Ventilator.—Figs. 19 and 21 to 26.

The ventilator is a plain casting, having only top and sides of ½ inch and 3/8 inch thickness, respectively. The back is entirely open; the bottom is formed by the lintel, to which the casting is screwed, and the front is a separate frame, containing a shutter 18 ¼ inches long by 10 ½ inches high, pivoted at the sides a little above the centre, so that preponderance below will close the shutter when released from a pin at the side of the frame, where it will be held by a light chain of open links, to regulate the aperture for the draught. The chain is not shown on the drawing.

Ventilator shutter, Figs. 19 and 26.

NOTE.—One of these ventilators will be located under the enclosed stairs, and the corner of the shutter will have to be cut off, to let it open clear of the stair-casing.

Neat joints required.

Holes to be drilled.

The moulding of the ventilator-frame must join neatly with the mouldings on the window jambs, and all surfaces of contact, if not cast sufficiently smooth, must be planed to form closely-fitting joints. All holes must be drilled, and the parts secured together with wrought-iron bolts and nuts ½ and inch diameter, and of the number indicated on the drawing.

Tower Necking or Belt Course.—Figs. 8, 12, 27, and 28.

The necking of the tower (called "belt course" on the drawing) is to be of cast iron, in sixteen (16) equal segments, with side flanges and chipping-pieces at the radial joints, which must be accurately planed and made weather-tight.

Flanges.

The side flanges will be secured together with $^5/_8$-inch bolts and nuts, but the two which secure the segments to the brackets will be 1 inch diameter. The lower edge of the belt will be tied at the joint by a strip of ¼-inch plate iron, and $^3/_8$-inch screws and nuts, the screw-heads countersunk outside.

Joints weather-tight.

NOTE.—All joints between the different casting exposed to the weather must be made perfectly water-tight by accurate planning and the use of red-lead clement, or a cement equally as good.

SPECIFICATIONS

FOR THE

LANTERN OF A FIRST ORDER LIGHT-HOUSE,
(IRON PARAPET.)

Cape Hatteras Light-House.

PLATE NO. 16

Principal parts.

The plan of the lantern above the gallery is a regular polygon of sixteen (16) sides. The principal parts are the inner and outer galleries forming the base, the metal framing of sash-bars for the plate glass, the cast-iron cornice, and the pyramidal roof and ventilator of copper.

Gallery Plates.—Figs. 1 to 8.

The gallery will consist of sixteen (16) cast-iron segments, fourteen of which will be full castings, as shown in plan at Fig. 1.

Stair opening, Figs. 5 and 8.

The two remaining segments will be cast with their inner portions omitted.

By this modification of the gallery plates, an opening is formed to accommodate the lantern stairs. The edge of the opening will be moulded similarly to the front edge of the lantern steps.

Outside diameter of gallery.

The segments, when joined together, will form an annular plate, with an extreme outside diameter of 16 feet 4 inches.

Lens opening.

The central opening for the illuminating apparatus will be 7 feet diameter. The edge will be surrounded by a moulded flange, and have a round bead projecting above the surface of the plates. One of the plates will contain a stove-pipe hole, five-and-a-half (5½) inches diameter, so located on the land side as to obstruct the least amount of light. The superintendent of work will determine its position after the lantern has been erected.

Stove pipe hole.

Checkering.

The upper surfaces of the segments must be checkered to the depth of 1/8 inch.

Thickness.

The plates of the gallery will be $^5/_8$ inch thick, and connected at the sides by radial flanges, 1 inch thick, by which the contiguous segments will be held together with four (4) wrought-iron bolts, ¾ of an inch diameter.

Flanges and bolts.

Sockets for posts.

Rectangular vertical sockets must be formed for the lantern-posts, each of which latter will be held by two (2) bolts, ¾ inch diameter, provided with suitable nuts and washers.

Air channels, Figs. 5 and 8.

Each *alternate* gallery segment is to have a channel cast beneath it, communicating with the interior of the lantern from the outside through a register, shown on Plate No. 17, Figs. 7, 8 and 10.

Surfaces of contact planed, &c.

The radial joints, recessed for lantern-posts, washers for railing-standards, the seats of the bronze sills, the undersides of the flanges for bolting to the parapet, and all other surfaces of metallic contact must be planed and accurately fitted. The holes for the railing-standard must be bored or reamed out.

All bolt-holes must be drilled, and the bolts turned to fit tightly.

Method of fitting.

First plane the radial joints, and bolt all the segments together; then face the seats for the sills in a boring mill, and accurately lay out the positions of the lantern-posts and railing-standards. When this is accomplished, the segments may be separated, if necessary, and the rest of the fitting executed. The same method should be observed in fitting the cornice of lantern.

Lantern Stairs.—Figs. 9 to 15.

Height of watch-room.

The height of the watch-room from the surface of the floor to the top of the lantern-gallery will be 9 feet 1½ inches.

Number of steps.

The gallery will be reached by a flight of eleven (11) cast-iron steps, (the gallery making the 12th,) each of $9^1/_8$ inches rise.

Stringers, Fig. 15.

The steps will be bolted to two curved carriers of bar iron, ¾ inch thick; the inner one to be 3½ inches wide, the outer, next to the wall, 4½ inches wide, and placed 21½ inches apart in the clear. They will have palms ¾ of an inch thick by 3 inches wide, turned

Fastenings.

inward and forged on each end for bolting to the watch-room floor and to the radial flange of one of the gallery-plates modified for that purpose. Through the latter, four (4) bolts, $^5/_8$ inch diameter, will hold each palm. (See elevation of Fig. 6.) The foot of each carrier will be secured to watch-room floor with two (2) wrought-iron bolts and nuts, $^7/_8$ inch diameter.

Thickness of steps.

The tread of each step to be ½ inch thick, the upper surface roughened with diamond checkering $^1/_{16}$ inch deep. On each end of step there will be a flange $^5/_8$ inch thick, by which it is secured to the carriers with wrought-iron bolts and nuts, $^5/_8$ of an inch diameter. The rear bolt through the inner flange of the fourth step from the floor, will also secure the end of the rail which guards the main stair opening. (See Plate 13, Figs. 1, 2, and 3, and their sections.)

Attachment of hand-rail, Fig. 14.

Ladder shelf, Fig. 13½.

To facilitate entrance into the lens, a cast-iron shelf will be attached to the inner carrier of the lantern-stairs, at the level of the eighth step from the floor.

The two bolts which secure the inner flange of the step will also pass through the flange of the shelf.

Shelf brackets.

The edge of the shelf is notched to receive the carrier, and the flange is thickened up to $^5/_8$ of an inch for strength where the bolts penetrate it. The corner of shelf opposite that against the carrier, is supported by a curved bracket of plate-iron, ½ inch thick, secured to the carrier by the bolts which fasten the inner flanges of the sixth and seventh steps.

The edge of shelf next the axis of lantern is supported by a strut of bar iron, 4 inches wide by ½ inch thick, the lower end held by the inner bolts of the sixth step.

Checkering.

The surface of the shelf is checkered to the depth of $^1/_{16}$ of an inch.

Clock-Work Pedestal.—Figs. 16 to 19.

Stand may be formed of several pieces.

The iron stand for supporting the revolving machinery is represented on the drawing as a single casting; but if it will facilitate the work, the sides and top may be cast in separate pieces, strongly connected together by wrought-iron bolts and nuts, ¾ of an inch diameter through flanges, say ¾ inch thick, running up at the corners of the stand its full height. The top, also must be securely bolted down to a suitable flange with ½-inch bolts.

Corner flanges.

Thickness.

Bottom flange.

The general thickness of the stand will be ½ and inch; the sides open, and the edges of the openings moulded. The bottom horizontal flange must be planed, and rest upon the watch-room deck, to which it will be secured by eight (8) bolts, ¾ inch diameter. The top of the stand must, likewise, by planed and made perfectly level when finally placed in position at the light-house.

Curved Barrel.—Fig. 20.

Diameter.

The barrel is of cast iron, 3/8 of an inch thick, having a variable diameter of 6 inches in the middle, and 4 inches near the ends, where a flange ¼ inch thick will be raised 1 inch all around.

The object in curving this barrel is to prevent the successive coils of the cord from "riding up" one upon another, in the process of winding up the weight.

Centre pin.

The pin upon which the barrel revolved is of wrought iron, 1 ¼ inch diameter; the bearings within the barrel to be 3 inches long, stiffened by six webs to the interior of the shell.

Turning, boring, &c.
Oil holes.

The surface of the barrel between the flanges will be smoothly turned, the hubs accurately bored out and face, and frilled with small oil holes, as shown.

This barrel must be fitted in its place before the pulley-casting (Plate No. 10, Fig. 7,) is bolted between the watch-room floor beams.

Fixed pulley, Fig. 20.

The pulley, which revolves between the bridges or cheeks M of the casting, will be of cast iron, 8 inches extreme diameter, with a V groove, 1½ inch deep, and about 2½ inches with at the periphery, being thus spread, in order that the cord in changing its angle of direction from side to side, shall not be frayed by the edges of the flanges. The groove must be smoothly turned, and the hub of pulley accurately faced, and bored out to 1¼-inch diameter, for revolving upon the wrought-iron pin, which must be turned and finished with a head at one end, and a washer and pin for securing it at the other.

Pulley bolt, Plate No. 10, Fig. 7½.

Watch-Room Cornice.—Fig. 21

General thickness.

The watch-room will have a cast-iron cornice, 8 inches deep, in sixteen (16) equal segments, curved to fit against the wall between the radial flanges of the gallery-plates. The segments will be $^3/_8$ inch thick, and each be secured by four (4) wrought-iron screws, tapped into the ears on the upper edge. The heads of the screws will countersink into the upper surface of the lantern-gallery, near the mullion sills. The lower corners of segments to be held, also, by a screw, tapped under the socket of each lantern-post, the head countersunk in the lower edge of cornice. (See Fig. 21, for the section, and the segment is drawn in plan just beneath.)

PLATE NO. 17.

Lantern Railing.—Figs. 11 to 15.

Standards, Fig. 11 and 12.

The railing-standards will be sixteen (16) in number, of wrought iron, and tool-finished. They will be sufficiently high to bring the rail to a level with the mullions, which separate the middle and lower panes of lantern glass; diameter of the lower part 1¼ inch, tapering to ¾ inch at the top under the collar. Just below the lower collar, a square will be forged on each standard, for receiving the ½-inch tap-screw which holds the lower rail.

Lower rail, Fig. 15.

This rail will be of bar iron, 1½ inch wide by ½ inch thick, made in four (4) sections, with scarf-joints, $1^5/_8$ inch long, lapping against standards. (See Fig. 11.)

Nuts and washers underneath.

The lower end of each standard will be secured to the gallery with a wrought-iron nut, 1¼ inch diameter, screwed against a suitable washer underneath the gallery at its outer edge.

Upper rail, Fig. 14.

The top rail is to be of bar iron, 2 inches by ½ inch, made in four (4) equal circular segments, with scarf-joints, 2 inches long, drilled with $^5/_8$-inch holes, to go over the standards. The rail is to be secured with tool-finished brass nuts, their upper ends being closed, as shown in Fig. 12.

Lantern Posts.—Figs. 1, 2, and 6.

The sixteen (16) wrought-iron lantern-posts will be planed and finished to the following dimensions: 3¾ inches width, 1¼ inch thickness, and 11 feet 5½ inches extreme length; to be set vertically in their sockets, at equal distances apart around the base, with their inner edges 5 feet 9 inches from the axis of the lantern. They will be let into the gallery 8½ inches, and into the cornice 8 inches; being reduced at the upper ends to a width of 2½ inches.

Bolts.

Each end of post is to be secured in its socket with two (2) wrought-iron tool-finished bolts, ¾ inch diameter, turned to fit tightly.

Rebates and glass stops.

For securing the plate glass, each post must be fitted on the outer edge with finished bronze rebates and stops in three (3) sections; each section secured to its post with four (4) bronze tap-screws, 5/16 inch diameter, the screw-head entering its whole depth. The vertical glass-stops of the upper and middle panes are fastened with five (5) bronze tap-screws, three (3) of which secure each handle. The lower stop is held by three (3) tap-screws, like the others.

Handles, Fig. 3.

There will be two (2) bronze handles to each post, finished bright all over.

Mullion Sills.—Figs. 2, 8, 9, and 10.

The bronze mullion sills must be equal in length to the space between the lantern-posts; width 4½ inches, height 4 inches, least thickness $^3/_8$ inch; thickness of flanges, including chipping-pieces, $^7/_8$ inch. The rebates and glass stops, the end flanges, and the under sides, in contact with the gallery-plates, must all be planed. Each horizontal glass-stop, of both the sills and sash-bars, will be secured with three bronze screws, $^5/_{16}$ inch diameter.

Glass stops.

Slide bolts.

The sills will be secured to each lantern-post, with one wrought-iron tool-finished bolts $^7/_8$ inch diameter, furnished with a suitable nut and washer, and additionally to each gallery-plate, with two (2) wrought-iron screws, ¾ inch diameter, tapped into the gallery-plate. These screws will have countersunk heads, and will pass through washers cast under the sill, and upon the gallery-plates, to give a solid bearing.

Air register, Figs. 7, 8, and 10.

Each alternate sill will contain a gridiron valve, communicating with the air-channel in the gallery-plate. The valve will contain five (5) openings, similar to those in its seat, 2¾ inches by 1¼ inch. The stroke will be regulated by stops on each side of the valve, which strike against small screws tapped into the flanges of the sill, which also serve to keep the valve on its seat.

Mullions, or sash bars, Figs. 4 and 5.

There will be two (2) sets of intermediate horizontal mullions, made of bronze, of form and dimensions shown. Their relative positions on the posts are shown in Fig. 2. (See, also, Plate No. 12).

Rebates, glass-stops, and end-palms, must be planed. Each glass-stop will be secured with three (3) bronze tap-screws, $^5/_{16}$ inch diameter. The mullions will be secured to each lantern-post with two (2) wrought-iron tool-finished bolts, $^5/_8$ inch diameter, furnished with suitable nuts and washers.

Glass.

Size and quality of glass.

The glass for the lantern is to be of the best French plate, not less than $^3/_8$ of an inch thick, all the panes to be of the uniform width of 2 feet $4^3/_{16}$ inches, of the following heights, viz: bottom panes 2 feet $6^7/_8$ inches; middles, 3 feet $3^3/_{16}$ inches; top, 3 feet 8¾ inches. These dimensions allow a clearance of $^1/_{32}$ of an each around each pane, for fitting.

Contractor will not furnish.

NOTE.—The glass above described will not be furnished by the contractor for the iron work. He will, therefore, not include its cost in his estimate.

Lens Column.—Figs. 16, 17, and 18.

The base of the column is 2 feet 5 inches square, and will set immediately over the pulley-casting, to the flanges of which it will be secured by six (6) wrought-iron bolts and nuts, 1 inch diameter. The head of the column forms a table 2 feet 2 inches diameter for the wheels, carrying the flashing panels of the lens; the path of these wheels being the wrought-iron ring which is shrunken in the place prepared for it; the surface of table is turned off, and the entire column finished bright. Base

The table and base will be strengthened by ribs inside.

The diameters of the projection above the head of column will depend upon the dimensions of the old lens socket, as will also the general height of column. Sizes to be furnished from old lens, &c.

NOTE.—The column must not be cast until the correct dimensions can be furnished, from measurements taken from the lens.

Lens Adjustment.—Fig. 19.

For bringing the lens column to a perpendicular position, there will be four (4) screws, 1 ¼ inch diameter, (one at each corner of the base,) the points of which will come up against the bottom flange of the column.

Each screw works in a brass nut or bushing, which is screwed down by its ears to the surface of the pulley-casting. After these four screws have performed their office, the weight of the lens must be borne by a series of wedges driven hard between the base and the chipping-pieces on the watch-room floor; the adjusting screws will then be "backed out," and the base-bolts tightly screwed up. Brass nuts. Wedges.

PLATE NO. 18.

Lantern Roof, &c.

The cast-iron cornice of lantern will be made in sixteen (16) equal segments. Cornice, Figs. 1, 3, 5, and 6.

The rebates, end-flanges, recesses for the lantern-posts and rafters, and the bronze glass strips (or stops) must all be planed. When the segments are bolted together, the sockets for the posts will measure 2½ inches by 1¼, the metal surrounding them $^5/_8$ inch thick. The segments will be secured together by means of flanges on the interior, using wrought-iron bolts, nuts and washers, $^5/_8$ inch diameter. The glass strips will be secured with screws of the same kind and number as those for the sills and intermediate mullions. Planed surfaces. Eyes for tie-rods.

There is but one ear to each segment, by which the tie-rod is secured. Stays.

In Fig. 6 are shown the rafters and stays, forming the frame of roof; they will be of wrought-iron bars, 2 inches wide by ½ inch thick.

All bolt-holes in the cornice, and throughout the lantern, to be drilled and reamed out, the bolts to be tool-finished, and make to fit tightly. Bolt-holes.

A bronze curtain-hook to be tapped in just beneath the tie-rod car in the part of cornice-segment surrounding upper end of post. Curtain hooks.

Rafters.—Figs. 1, 6, and 10.

The lower end of each rafter will be secured to the flanges of the cornice-segments, with two (2) wrought-iron bolts, nuts, and washers, $^5/_8$ inch diameter. Rafters.

The upper flanged end must be secured to the cast-iron crown-piece with one (1) wrought-iron bolt, $^5/_8$ inch diameter. The stays (Fig. 2) must be secured to each rib with two (2) wrought-iron bolts, ½ inch diameter, through their palms, forged on each end. Upper flanges of rafters.

The cast-iron crown-piece of dome consists of a polygonal ring, having an internal diameter of 12 inches, a depth of 4 inches, and a thickness of 1 inch. All the rafters are clustered together, and each let into and bolted at its notch on the outside of the ring. The crown-piece has four (4) arms, 4 inches deep, ¾ inch thick, sustaining a central socket 3 inches diameter by 4½ inches deep, into which a wrought-iron bolt, 1½ inch diameter, enters, and is secured by means of its collar, and a nut and washer, of suitable size. The bolt passes upward, and is screwed into the nut on the top of the globe, thereby fixing all parts of the ventilator firmly together. The socket in the crown-piece must be bored and faced, and the bolt turned to fit it. The notches for rafters must be planed, and the bolts turned to fit their holes tightly. Crown-piece of dome, Figs. 1, 8, and 11. Pinnacle bolt, Figs. 11 and 15.

The roof must be covered with sheet copper, $^1/_8$ of an inch thick, weighting 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 as shown in Fig. 18, 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. (See Fig. 19.) Copper roof, Figs. 1 and 11, also Plate No. 12. Lock joints, Figs. 18 and 19.

The roof-plates will be secured under the edge of the cornice by means of strips of 1¼-inch by $^5/_8$-inch by $^3/_8$-inch angle-iron, held in place by six (6) bronze tap-screws, $^3/_8$ inch Angle-iron strips.

diameter. The surface in contact with the copper must be planed. The roof will be held on the inside by six (6) ears of copper, with a ¼-inch screw through each, tapping into the side of rafter. At the apex of the roof the plates will extend two (2) inches under the scotia of the ventilator, the copper being slightly turned up, as sown at Figs. 1 and 11.

Globe.—Fig. 11

Dimensions, &c.

The globe and the other parts of the ventilator must all be of copper, of the same thickness as the roof. The globe is 28 inches diameter, and has in its lower part forty-eight (48) holes, 2 inches in diameter, arranged in two rows. The ventilator pipe is 19 inches in diameter; its lower part is moulded in the form of a scotia, the base of which is 31 inches in diameter, having on it a flange 3 inches wide, which will be riveted and soldered to the roof when finally erected upon the light-house.

Pipe.

The upper end of pipe will not touch the inside of the globe by ½ an inch. It will be perforated with fourteen (14) rectangular openings, each 4½ inches by 2 inches.

Brazing.

All the joints necessary for the construction of the above parts must be substantially brazed at the work-shop; and wherever any brazing can be substituted for soldering, and cause no inconvenience in packing and transporting the parts, or in fitting them together at the light-house, it must be done.

Rivets.

The globe passes over the pipe, but the rivets through the flange, indicated in Fig. 11, will be omitted, as the globe with require removing occasionally for cleaning. The pinnacle-bolt, will be sufficient to hold it in place.

Pinnacle, &c., Fig. 11.

The bronze nut and pinnacle to be cast in one piece.

The total height of the nut is 6½ inches, diameter of its base 8 inches, inside screw 1½ inch diameter.

Pinnacle nut.

The nut must be secured to the globe from the inside with 6 bronze screws, ¼ inch in diameter; heads similar to those used for securing the glass stops to the sash bars, &c. It must likewise be brazed to the top of the globe on the outside.

Pinnacle point.

The pinnacle projects 4 feet above the nut. The diameter of the lower part is 1½ inch, tapering to ½ inch at the top, where it must be furnished with a platinum point, and fire-gilt and burnished for six inches down from the tip.

Spider frame, Fig. 7.

The spider frame, supporting the adjustable bearing** for the upper part of the lens apparatus is to be of wrought iron, of the form and dimensions shown.

Tie rods, Fig. 1.

The horizontal tie-rods, sixteen (16) in number, are 1½ inch wide by ½ inch thick. The outer end of each must be secured to the ear on the cornice segment, with one (1) wrought-iron bolt, ½-inch diameter, the inner end to have a screw cut on it ¾ inch in diameter, whereby it is secured to a wrought-iron ring, 1¾ inch by 1¾ inch, which nuts inside and out, for adjustment.

Suspension Rods.—Figs. 1 and Sections.

Every alternate tie-rod is supported by a wrought-iron rod, 5/8 inch diameter, whose upper end is secured by its jaws to the rafters, near the apex of the roof, with one (1) bolt, ½ inch diameter; the lower end is secured to tie-rod in the same manner.

Turnbuckles, C., Fig. 16.

Cast-iron turn-buckles 3½ inches long, with right and left screws cut in them, are provided for adjustment.

Spindle socket, &c. Figs. 1, 7, and 9.

The journal bearings for the spindle, on the upper part of the lens apparatus, consists of a central socket of bronze, 2½ inches diameter by 2¼ inches deep, with four arms at right angles, the square end of each of which passes through a seat, and is adjustable therein by two (2) $^3/_8$-inch steel-set screws. The seats have two flanges each, by which they are fastened to the wrought-iron tie-ring with four countersunk screws of bronze, ¼ inch diameter. All parts of the bearing and seats must be finished bright all over. The upper side of tie-ring must be faced.

Finish.

Lantern Ladder.—Figs. 13, 14, and 17.

The upper (movable) ladder of lantern will be of wrought iron, of the form and dimensions indicated. The stingers to be 2 inches wide by $^3/_8$ inch thick; their distance apart from out to out 15 inches. Hooks of 1-inch round iron are formed on the upper ends for grasping the pieces of the 1¼-inch gas pipe supported by the cast-iron sockets, (Fig. 20,) screwed to the angles of the cornice. Each tread is formed of two rods, ½ inch diameter, placed so as to be horizontal when the ladder is in its inclined position against the lantern. The rods are reduced to ¼ inch diameter where they enter the stringers, to which they must be riveted.

Treads.

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*The form of this bearing depends entirely upon the construction of the upper part of lens framing, and hence the engineer in charge of the light-house construction or repairs should ascertain whether the bearing here specified is suited to the particular lens to be used. It may be added here, that the Parisian manufacturers, from whom the lenses are obtained, have in their later works formed the upper part of the lens frame so as to require a hollow bearing. The lens, it revolving, is provided with horizontal friction wheels to roll on the exterior of said bearing.

The drawings all show the neat dimensions of the finished work, but in all the castings and forgings extra thickness must be allowed, where necessary, for turning, boring, facing, &c., to secure good fitting. Drawings show finished dimensions.

Zinc Lining of Roof.—Fig. 1.

The inside of roof must lined with sheet zinc, $^1/_{32}$ of an inch thick, put on in sixteen (16) segments, with ¾-inch lap at the joints, and fastened to each rafter with six (6) wrought-iron screws ¼ inch diameter. Fastening.

The lower edge of each sheet must be secured to the lower flange of cornice segment with 4 wrought-iron screws, same size as above. Soldering, &c.

The upper edge of the sheet is to be fitted close up to the jaws of the suspending rods, and soldered to the rafters and roof. Where the sides of the sheets meet the vertical flanges of cornice, they must have flanges ¾ inch wide, and secured with two screws.

All the joints must be neatly fitted and made tight by soldering, in order to confine a stratum of air between the exterior and interior sheathings.

To prevent all drip or leakage from falling upon the lens, a conical hood made of the best XXX tin, is placed over it, and is to be fastened to the tie-rods with ¼-inch screws, tapped in. Hood for lens.

The height of the hood will be 2 feet; greater diameter, 7 feet; lesser diameter, 6 inches. Size.

The lower rim to be stiffened with iron wire not less than ¼ inch diameter, and the upper edge with wire not less than $^1/_8$ inch diameter; the latter sized wire is also to be used for the lower edge of the cone, which is immediately over the opening of hood. Edges stiffened.

This cone will be secured to the hood with standards of flat galvanized iron, riveted and soldered at both ends.

Eight tubes, 1¾ inch long by ¾ inch internal diameter, are to be soldered in the hood at the proper places, for permitting the tie-rod supporters to pass through.

Should it be required, all the copper-work, &c., must be weighed in the presence of the agent of the Light-house Board, and the total weight must not show a deficiency greater than two per centum of the weight due to the known surface. Weigh the copper, &c.

The contractor will be furnished with an extra set of drawings, upon which he will be required to mark the average weight of each piece of casting, forging, &c., and the price per pound of the same. Statement of weights.

All the wrought-iron work must be of the best quality of American charcoal iron, and the contractor must forward to the Light-house Board a certificate to this effect form the part supplying the iron. Quality of iron.

He must also forward a similar certificate from the party furnishing the castings hereinbefore specified or marked on the drawings as bronze, showing that the said castings have been made of pure copper and tin, and in the proportion of nine (9) parts of the former to one (1) part of the latter, by weight. Certificates.

The entire work must be completed in the best manner, and all the materials must be of the best quality of their several kinds. The castings must be sound, the forgings smooth and without flaws, and the machine and hand work faultless, or they will be subject to rejection. Materials and workmanship.

The contractor must provide all the rivets, bolts, and nuts, necessary to erect and complete the structure at the light-house.

The entire portion of the iron work above, and including the belt course, (represented in Plate No. 12,) must be completely fitted and bolted together at the workshop, when the manufacturer will notify the inspecting officer of its completion; in which condition the work will stand until that officer, after a strict examination of all its parts, shall be perfectly satisfied as to the soundness of the materials and workmanship; and until such thorough inspection be made, the work will be neither accepted nor paid for. Erection at the workshop. Inspection and acceptance.

Every facility must likewise be offered to the authorized agent of the Light-house Board for inspecting this and the other work during its progress.

In furnishing the metal work, precedence must be given such portions as are to be built in the brick work, (wall castings, window frames, floor beams, and shoes, &c.,) and held ready for delivery as required, upon the order of the engineer in charge of construction. Delivery of the work.

After the erection at the workshop, all the parts of the work must be marked with a chisel or centre-punch, or by letter and figure punches, where the materials will bear it; otherwise, the marking must be painted distinctly, and according to a system whereby there will be neither doubt nor difficulty in readjoining the parts in their subsequent erection. Marking.

When ready for shipment, such parts as are liable to be lost or injured will be packed in substantial boxes strapped with iron, and the contents of each box marked on its outside. Boxing.

Before the various parts of the work shall be shipped, they must all have a thorough coat of durable paint, of such color as the agent of the Light-house Board may direct. Painting.

All of the iron work of the lantern must have one coat of linseed oil, *laid on hot;* the small pieces to be immersed in hot linseed oil. After this treatment, the iron work, and all other parts of lantern not finished bright, are to have two coats of paint, white lead being used for the interior of lantern, (gallery excepted,) and black paint for the exterior. The inner gallery to have two coats of chrome green.

All of the above painting, &c., must be executed by the contractor before the work is exposed to the weather.

Protection of bright surfaces.

All parts of the *iron* work that have been planed, turned, or finished, must be well smeared with a mixture of white lead and tallow, to prevent rusting.

When the lantern shall have been erected on the light-house, it must have two coats of the same kind of paint as before; and interior, from the gallery upwards, must have, in addition, two coats of varnish.

Finally.

If any omission of details be discovered, either in the drawings or in these specifications, the contractor shall not take advantage of it, but will be expected to refer for information to the Light-house Board, or their agent; the Board claiming the right to order any details to be provided, without additional cost to the Government, should it become evident that such details were originally intended, or that they will be essential to the proper construction of the work.

Full explanations and complete detail drawings will be furnished for any parts of the work not sufficiently shown or understood.

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OF

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CAPE HATTERAS LIGHT-HOUSE.

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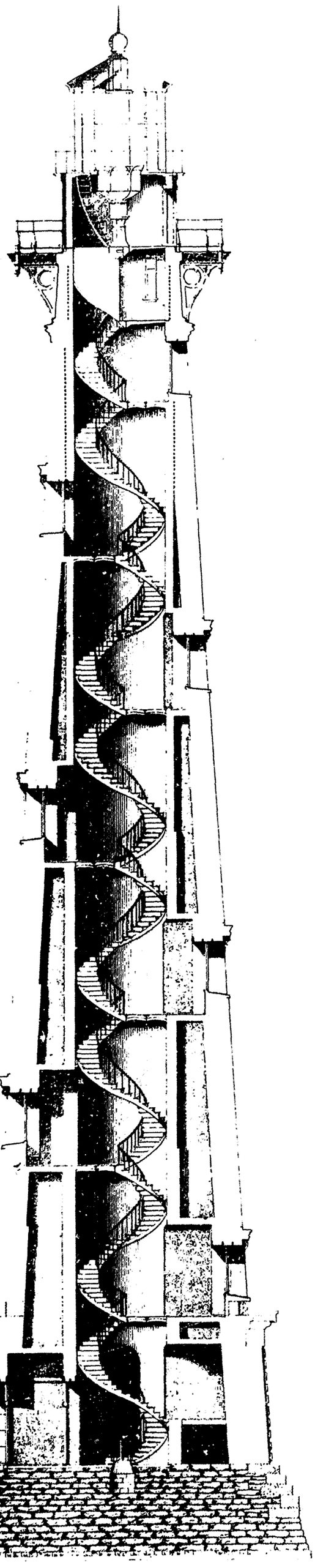
Sills, iron, for vestibule doors	5	14 and 15	16
Sill of lantern	17	7 to 10	32
Sills of parapet door	14	8 to 10, 14 and 15	26
Sills of tower window, iron	9	9 and 10	20
Skewback, tower door head	3	13	13
Socket for lens-spindle	18	1, 7, and 9	34
Socket for ladder support outside lantern	18	1 and 20	34
Spider-frame	18	1 and 7	34
Spreader for anchor-bolts	15	7	27
Stair-attachment to walls	7	17 to 19	18
Stair balusters	7	1 to 4, 24 to 26	19
Stair Casing flange	10	9 and 10	23
Stairs enclosed at top of tower	11	1 to 13	23
Stair opening in lantern gallery	16	5	30
Stairs, main, plans and elevation	7	1 to 4	11-19
Stand for clock-work	16	16 to 19	31
Standard for lantern railing	17	11 to 13	32
Stays between rafters	18	1, 2, 6, 8	33
Steps, details of treads, risers, spandrels, &c.	7	5 to 13	19
Steps enclosed at top of tower	11	8 to 13	23
Stairs to lantern gallery, stringer, &c.	16	9 to 15	30
Steps for oil-recess	6	15 to 17	17
Stoop foundation	4	10	12, 13
Stoop plans, elevation, section, and details	4	3, 4, 6 to 9	13
Stops and rebates for lantern glass	17	1, 2, and 6	32
Stingers for stairs	8	1 to 8	19
Suspending-rod for revolving weight	6	10	17
Suspension-rods and swivels for spider-frame	18	1 and 16	34
Swivel for suspension-rods	18	16	34
Tank for oil	6	1, 5	16, 17
Tie for foot of main bracket	15	6	27
Tie for heads of main brackets	15	11	26
Tiling of floor and landings	7	1 and 2	13, 14, 15
Tin shelter or cowl over lens	18	1	35
Top and bottom rails, lantern gallery	17	14 and 15	32
Tower windows in detail	9	……	20
Transom frame, tower entrance	5	10	15, 16, 24
Transom lights	5	4 and 5	15
Transom moulding	5	16	16
Transom rail or impost	5	1, 4, 5, and 13	16
Traversing pulley for weight cord	6	9	17-23
Traversing pulley bolt	10	12	23
Treads to oil recesses	6	15 to 17	17
Upper bracket shelves	15	10	23-26
Upper portion of tower	12	…….	24
Upper and lower rail, lantern gallery	17	14 and 15	32
Ventilator of service room	15	19, 21, 23, 25, 26	28
Ventilator globe and pipe of lantern	18	11	34
Vertical sections of tower	1 and 2	…….	11
Vestibule doors	5	1 to 9	15, 16
Vestibule, plan of	3	6	11-13
Vestibule, vertical sections	5	4 and 5	11-13
Wall castings, stair attachment	7	1, 2, 17 to 19	18
Watch room	12	…….	24
Watch-room cornice	16	6 and 21	31
Watch-room floor plates	10	1, 2, 3	21
Watch-room floor shelves on main brackets	11	16 to 20	24-26
Watch-room railing	13	1, 2, 3	24
Watch-room stairs, enclosed	11	1 to 13	23
Weight-cord barrel and pulley	16	20	31
Weight for revolving apparatus	6	11 to 14	17
Well curbing and railing	6	18 and 19	17
Do. do.	7	1 and 3	17
Windows of tower shaft	9	…….	20
Window brackets or consoles	9	17 to 20	21
Window catches, &c.	13	24	20
Window frame, head of sash	13	21	21
Window jambs	9	11 to 13	20
Window latches	13	18 and 19	20
Window lintel	9	21, 22	20, 21
Window lintel, seventh window	9	23 to 25	20
Window recesses	9	3 to 5	11, 14, 15
Window sash	9	1 to 8	20-24
Do.	13	15 to 24	20-24
Window sills	9	9 and 10	20
Window of service room	15	18, 21 to 25	28
Wooden door, parapet	14	7 to 10	16-26
Wooden door, tower entrance	5	4 to 7 and 9	16
Yoke for pulley guide	10	14	23
Yoke or shoe for foot of parapet ladder	13	14	25

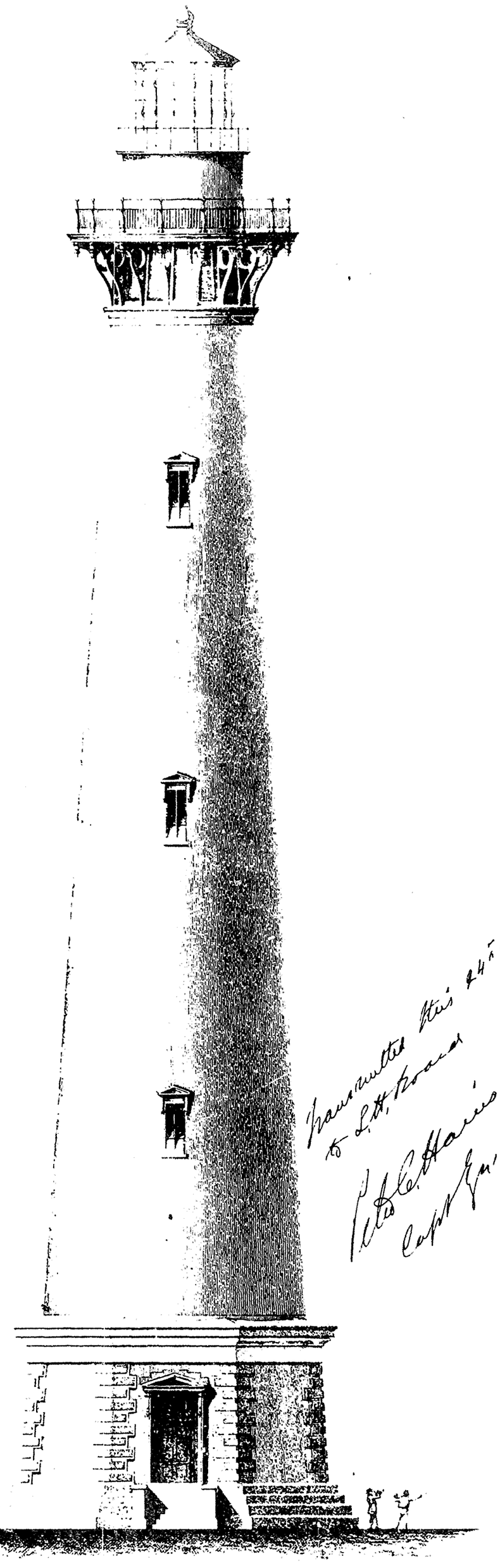
5th District

FIRST ORDER L.H. FOR CAPE HATTERAS, N.C.

Plate No. 1



VERTICAL SECTION



FRONT ELEVATION

Transmitted this 24th April 1871
to Lt. Francis
Chas. E. Harris
Capt. Engr. L.H.E.

Plate No. 1

1869

Engraved & printed by JULIUS BIEN N.Y.

5th Dist.
C J

Drawer for Weights.

with Engr's letter of 24 Apr. '71
filed 8 May

List of addition Plate II.

FILMED AT 29X

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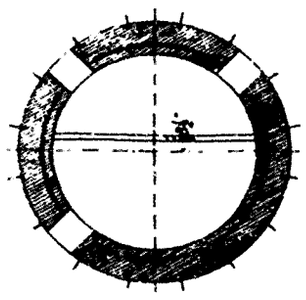
FIRST ORDER L.H. FOR CAPE HATTERAS, N.C.

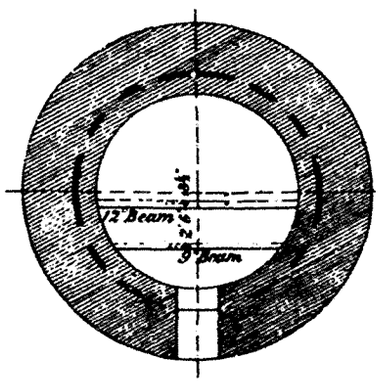
SECTIONS OF BRICK WORK

Size of Hatteras sample brick
8½" x 4" x 2½"

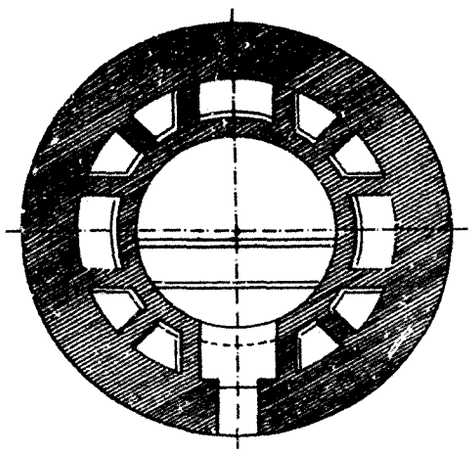
The length of one brick is the measure used to designate the thickness of the walls.
Make all beds and exposed joints of brickwork ¼" thick, and for hidden joints ⅜ of an inch.



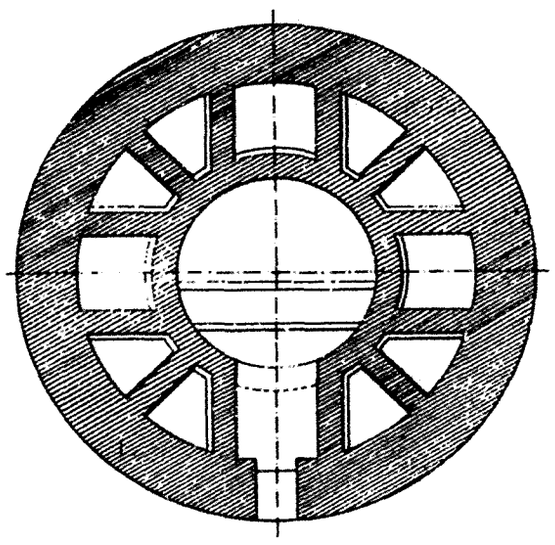
SECTION R S



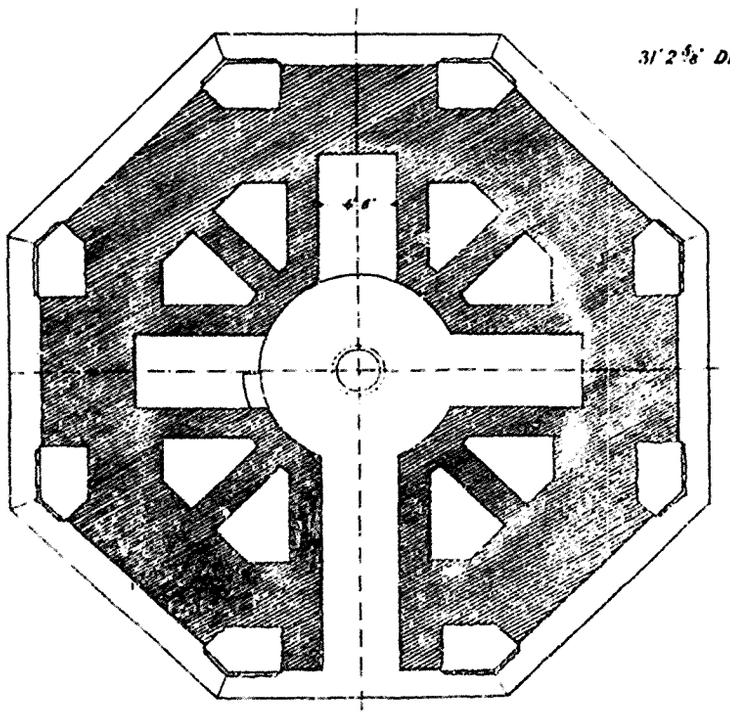
SECTION N O



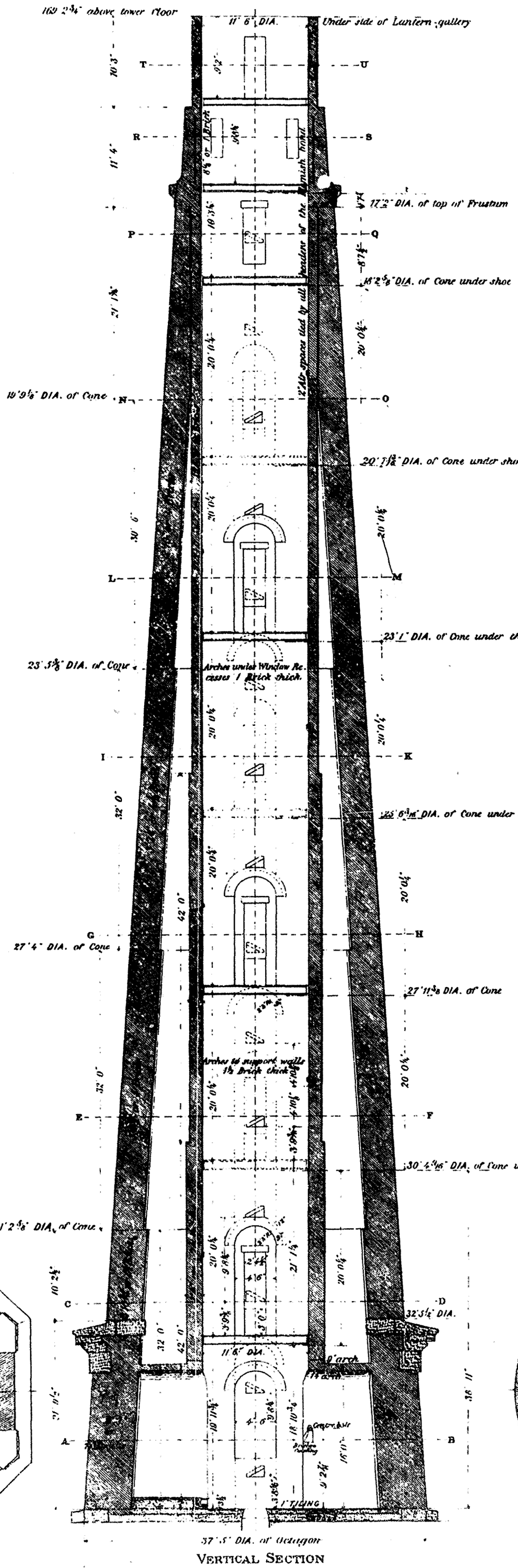
SECTION I K



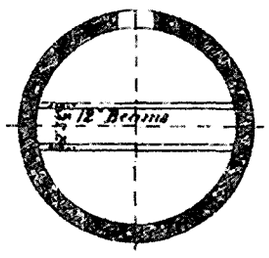
SECTION E F



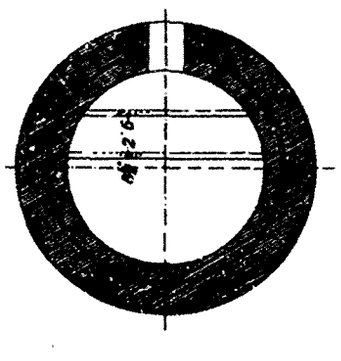
SECTION A B



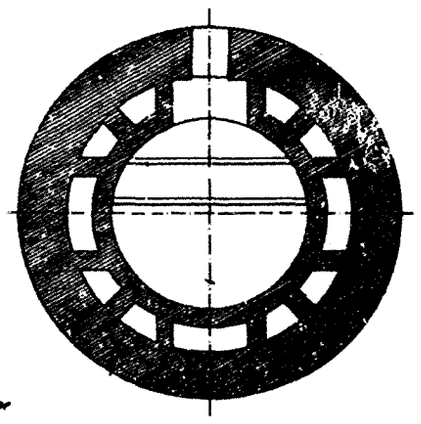
VERTICAL SECTION



SECTION T U

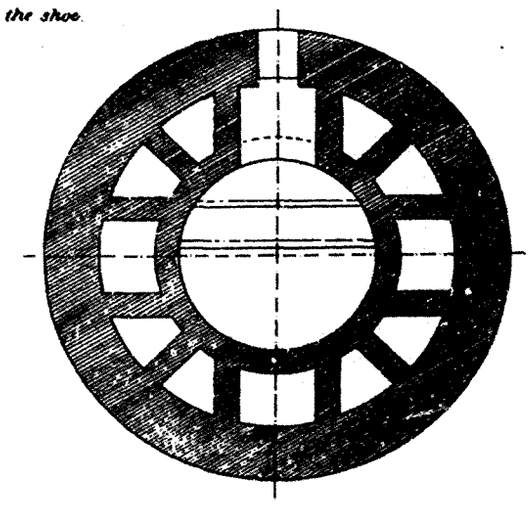


SECTION P Q

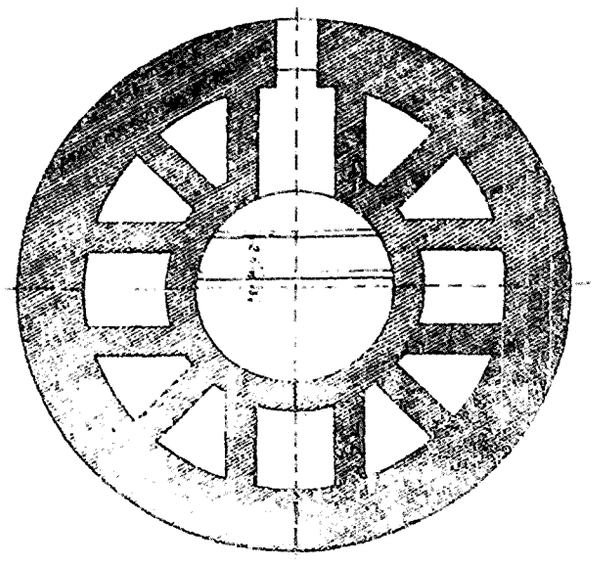


SECTION L M

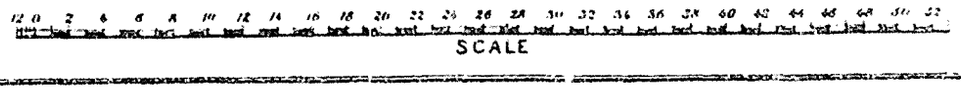
Centre of 12" Beams placed 8½" from axis of tower
" " 9" " " 2'6" " centre of 12" beams



SECTION G H



SECTION C D



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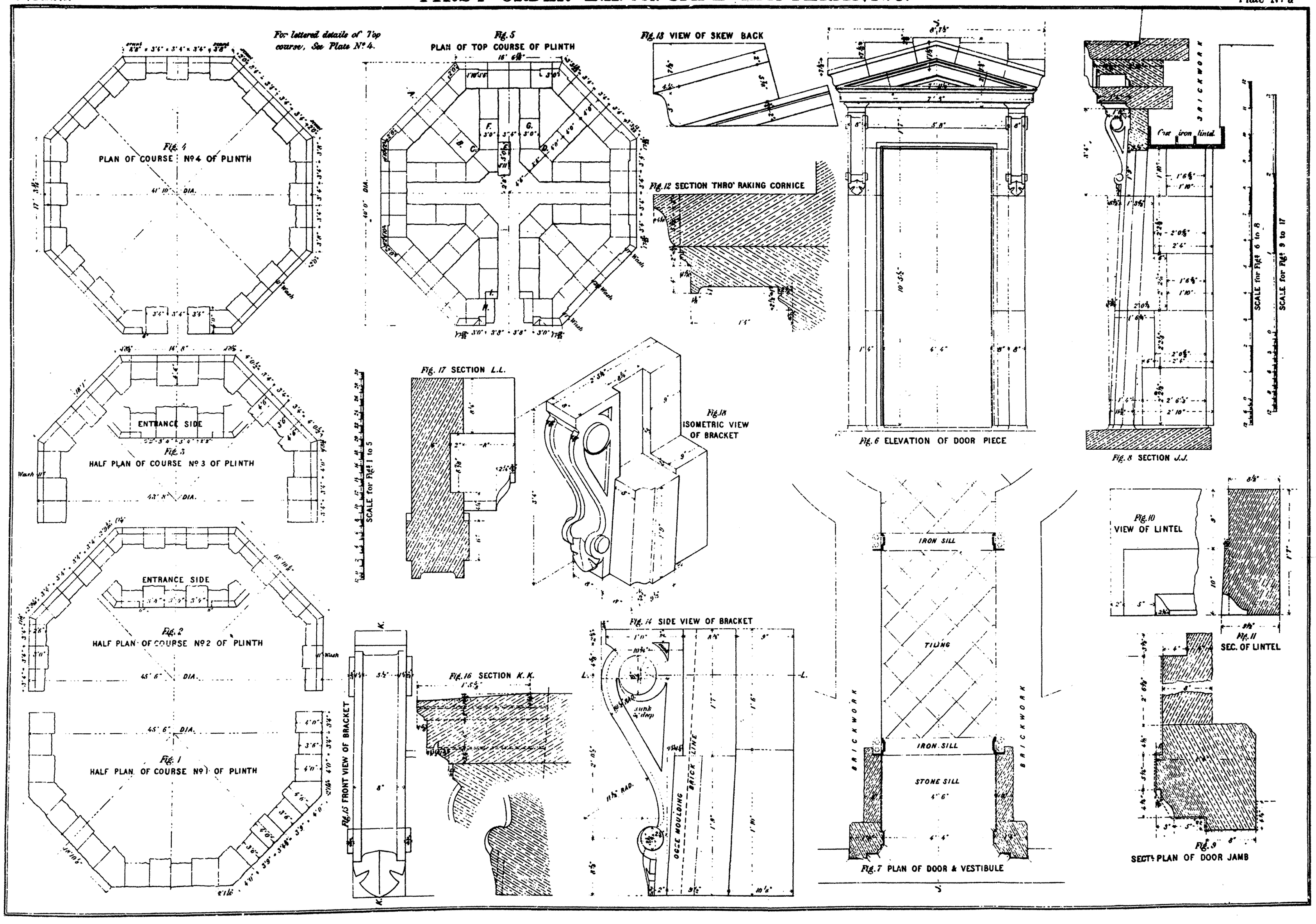
FIRST ORDER L.H. FOR CAPE HATTERAS, N.C.



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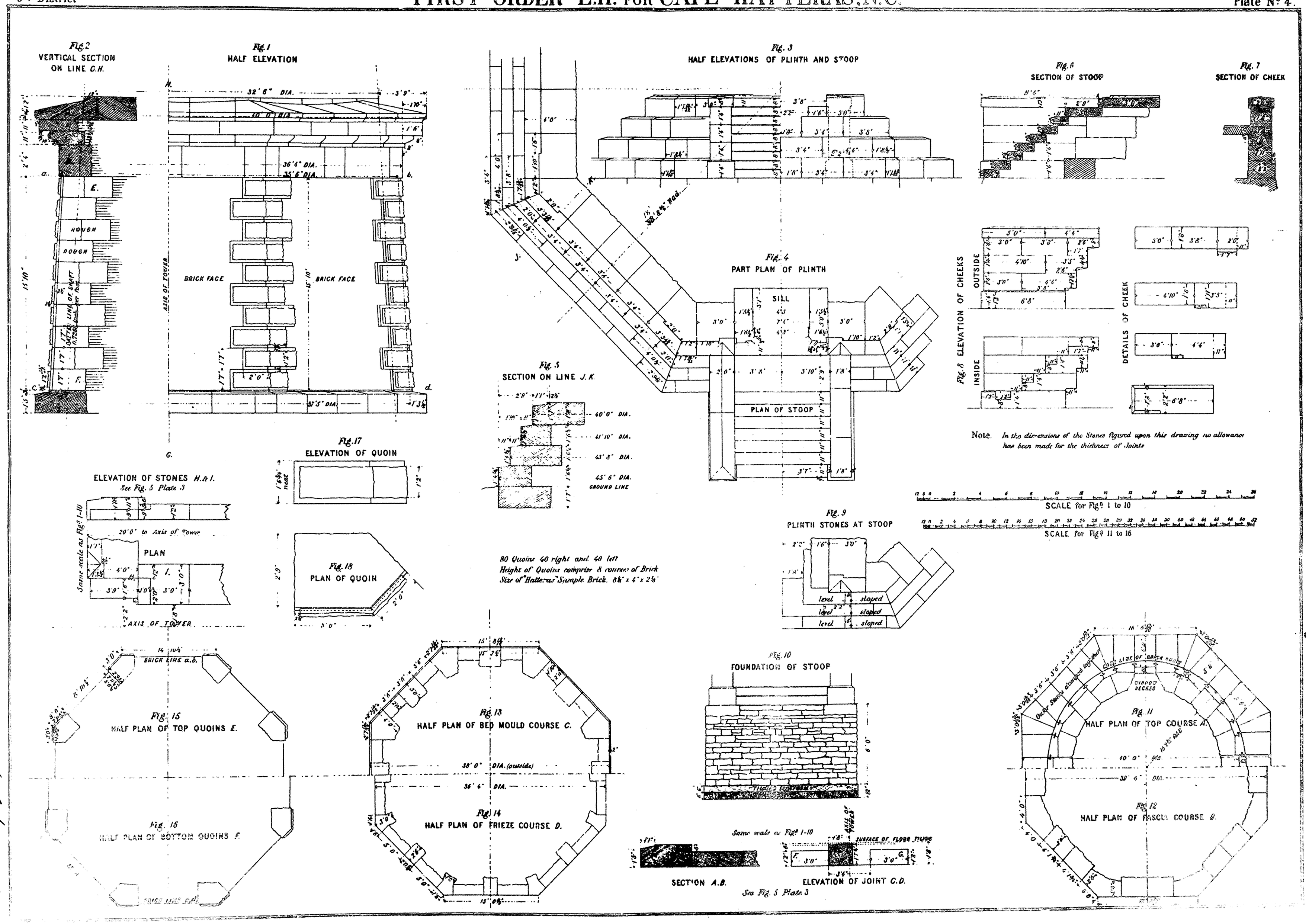
FIRST ORDER L.H. FOR CAPE HATTERAS, N.C.



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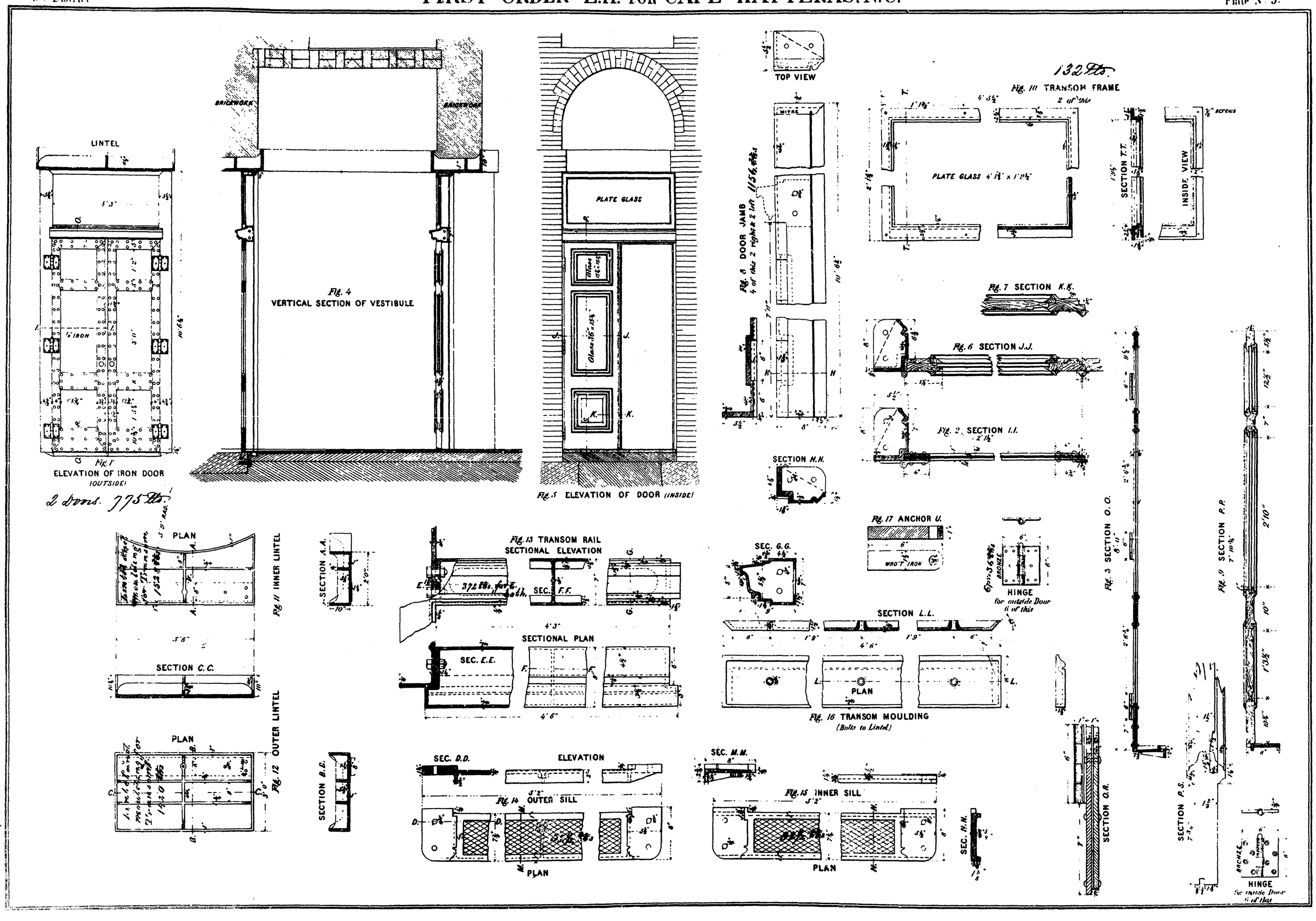
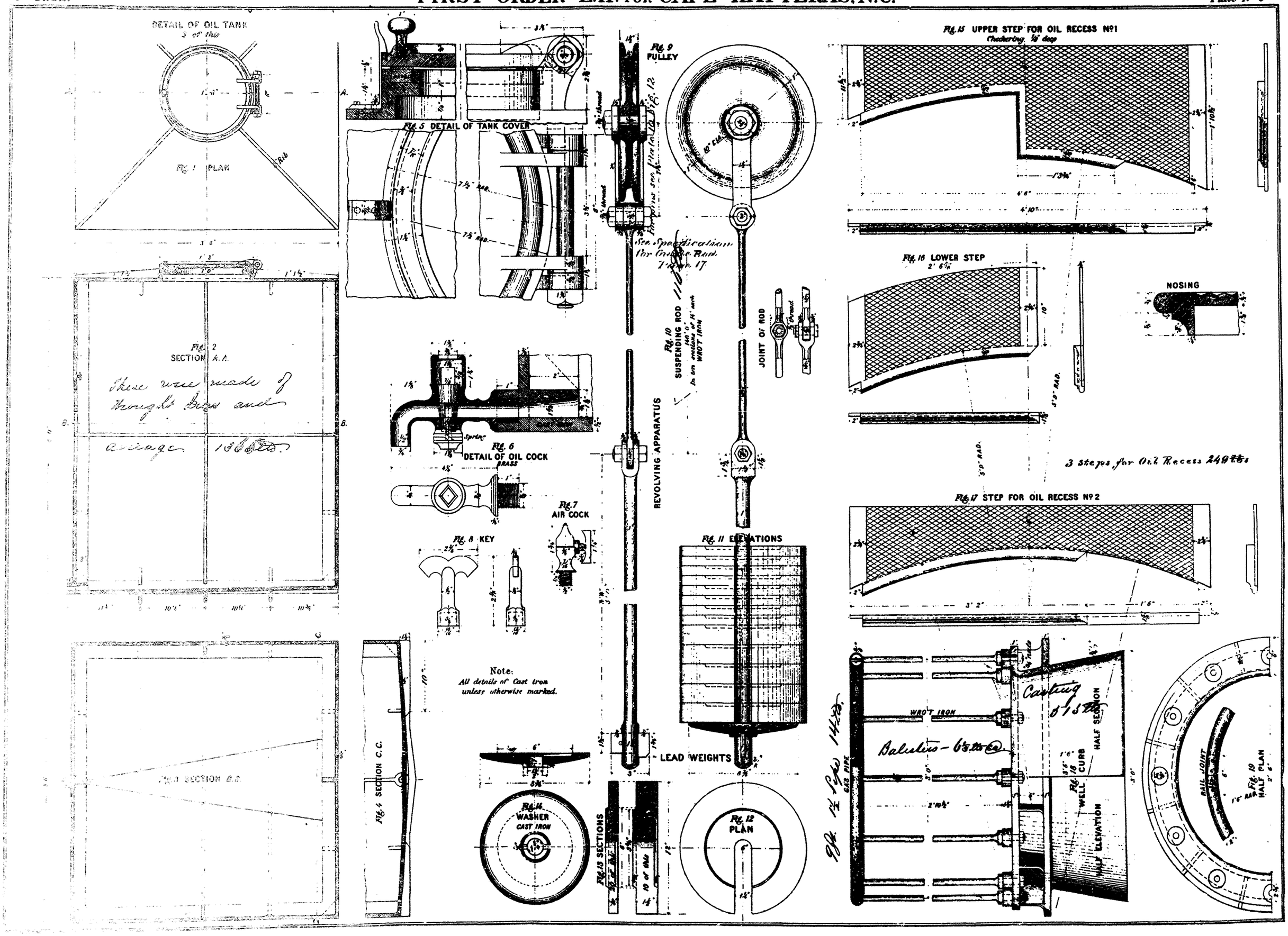


FIRST ORDER L.H. FOR CAPE HATTERAS, N.C.



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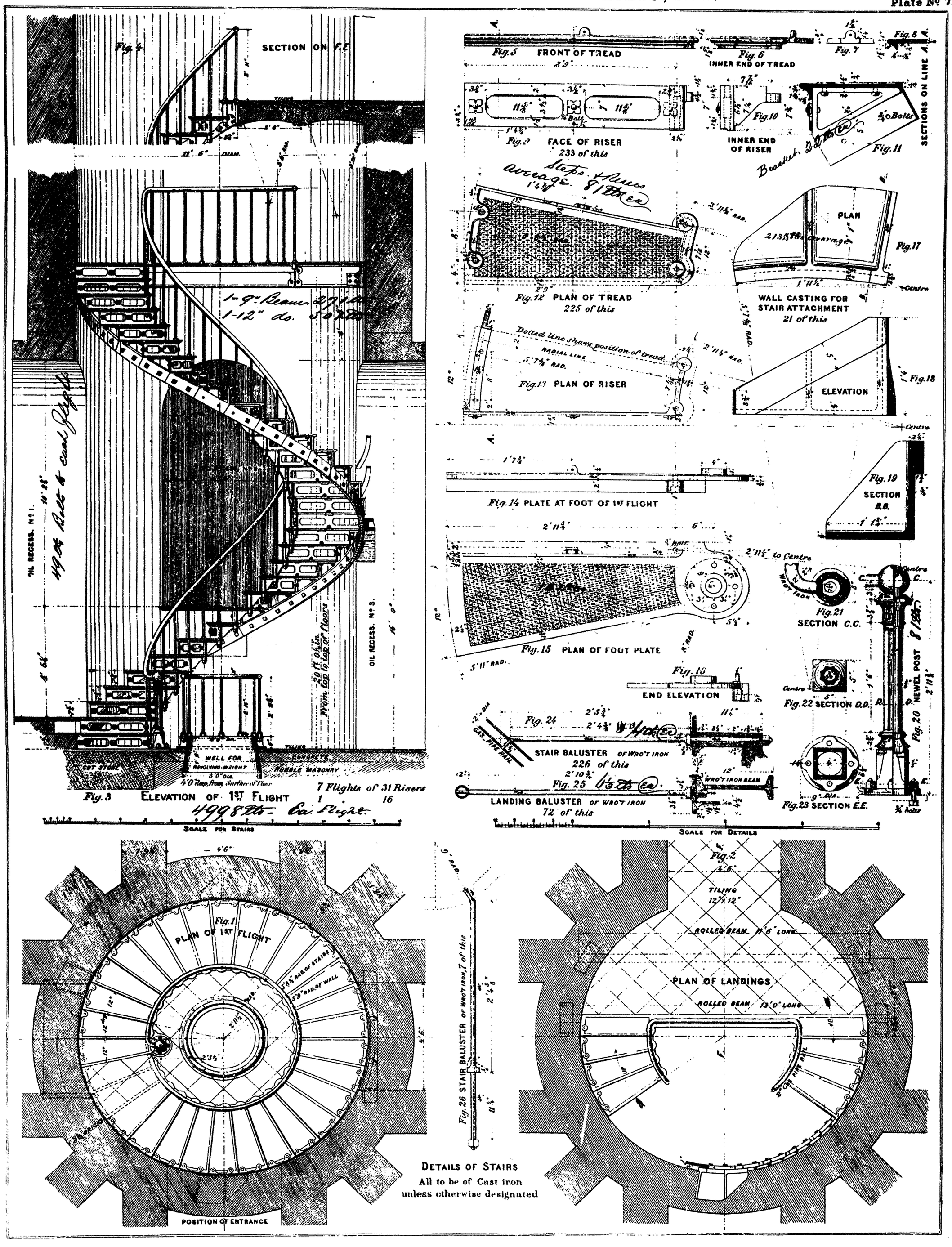
FIRST ORDER L.H. FOR CAPE HATTERAS, N.C.



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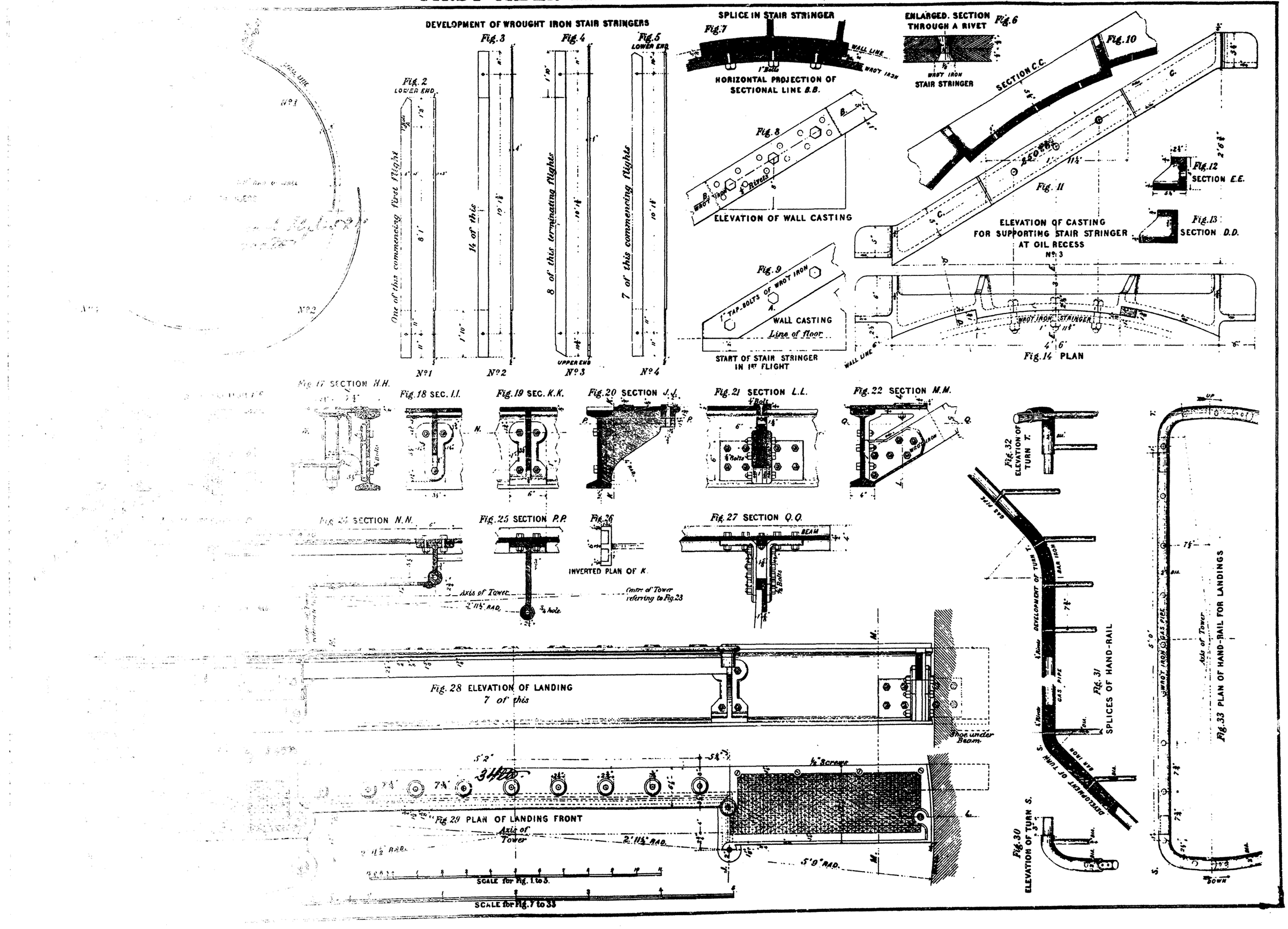
FIRST ORDER L.H. FOR CAPE HATTERAS, N.C.

Plate Nº8



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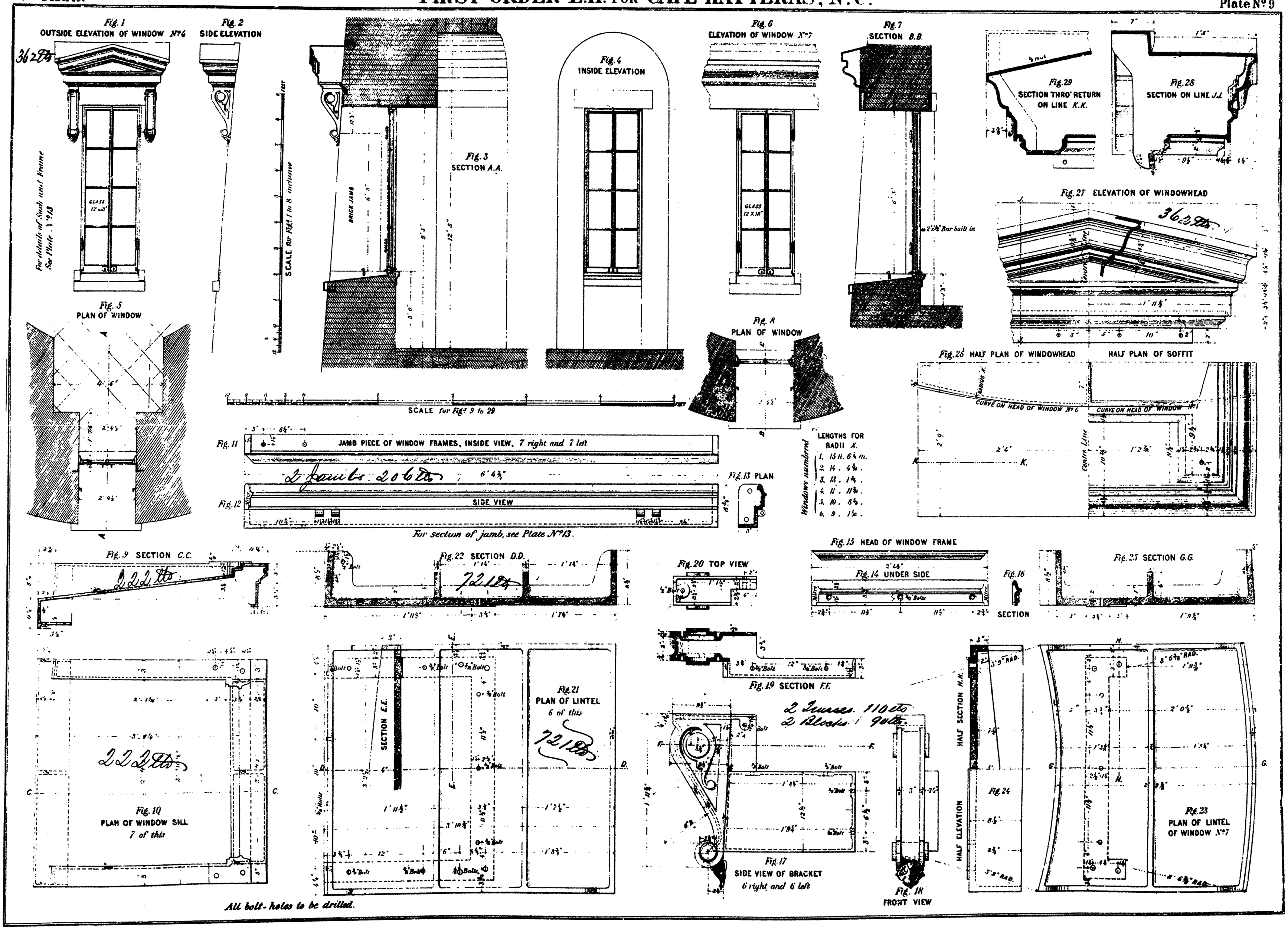

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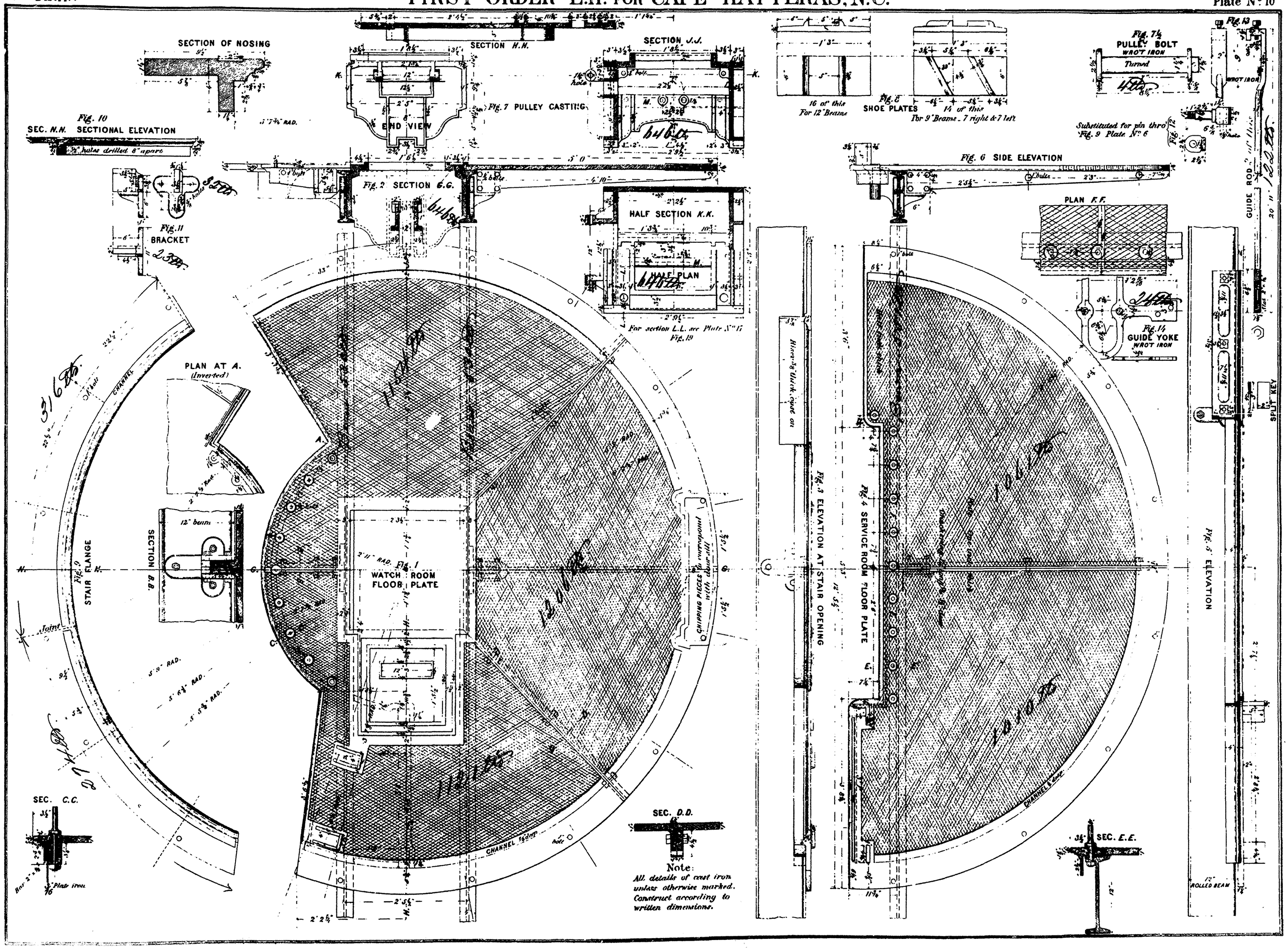

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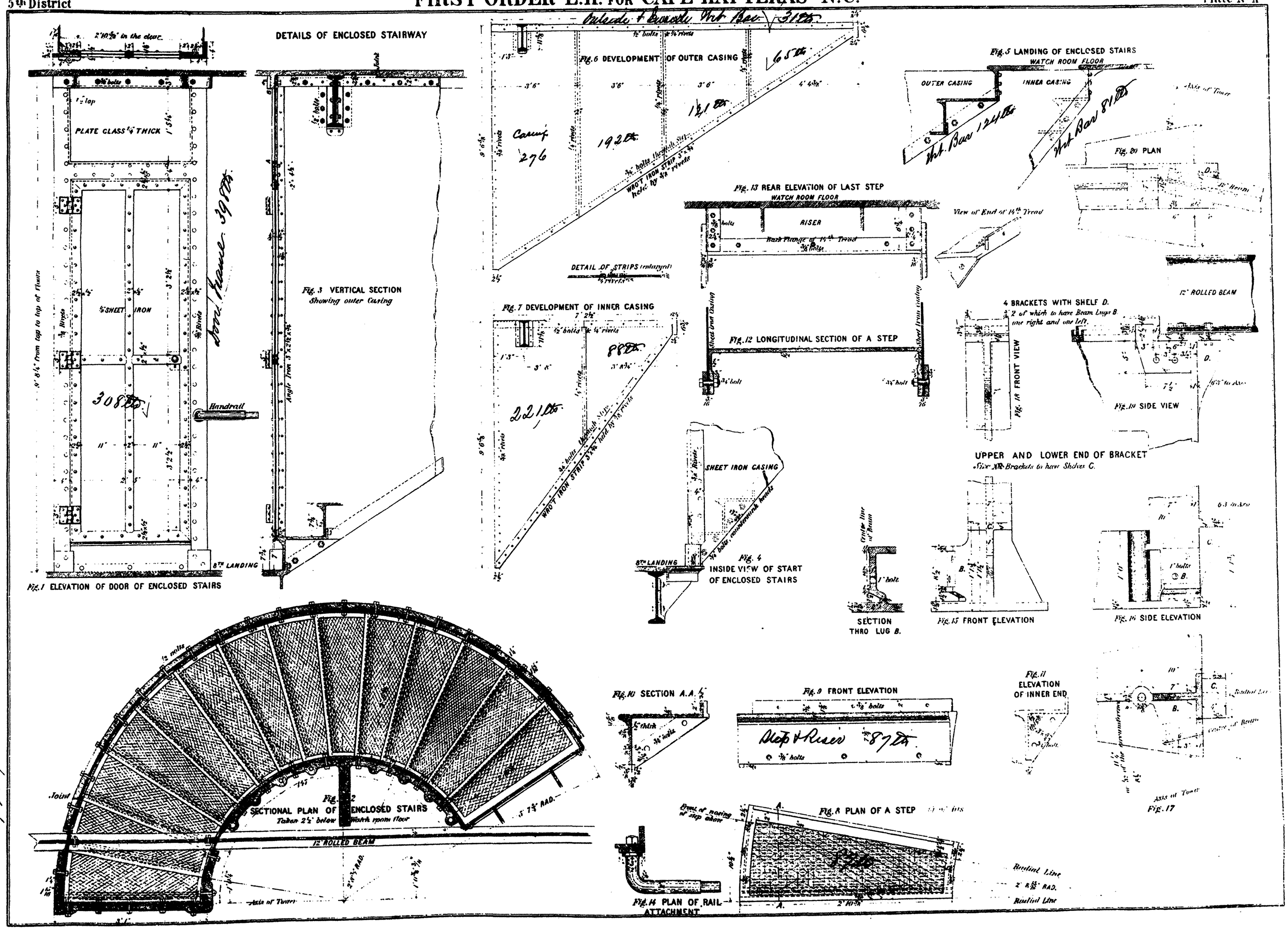

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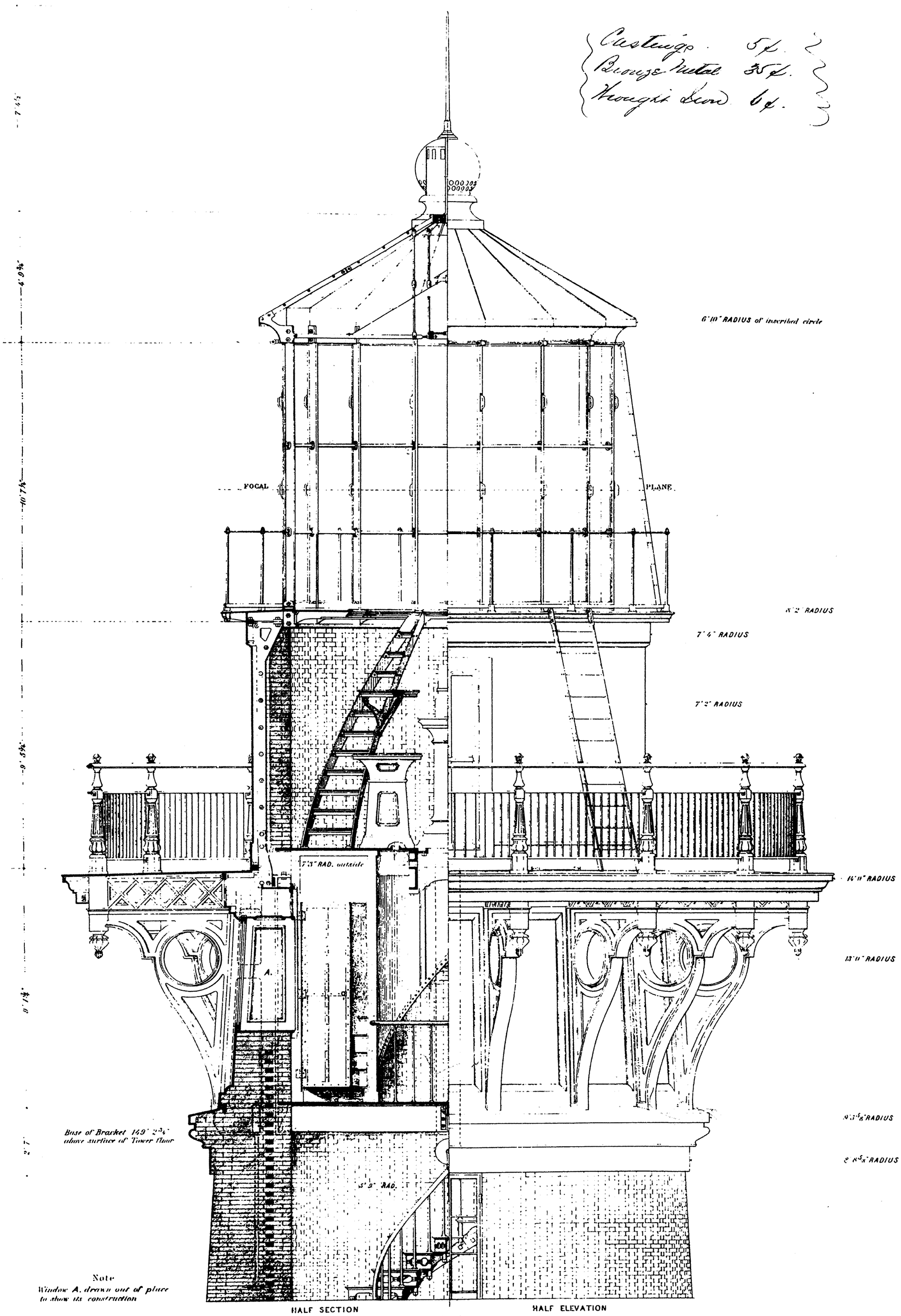
FIRST ORDER L.H. FOR CAPE HATTERAS, N.C.

UPPER PART OF TOWER



Note
Window A. drawn out of place to show its construction

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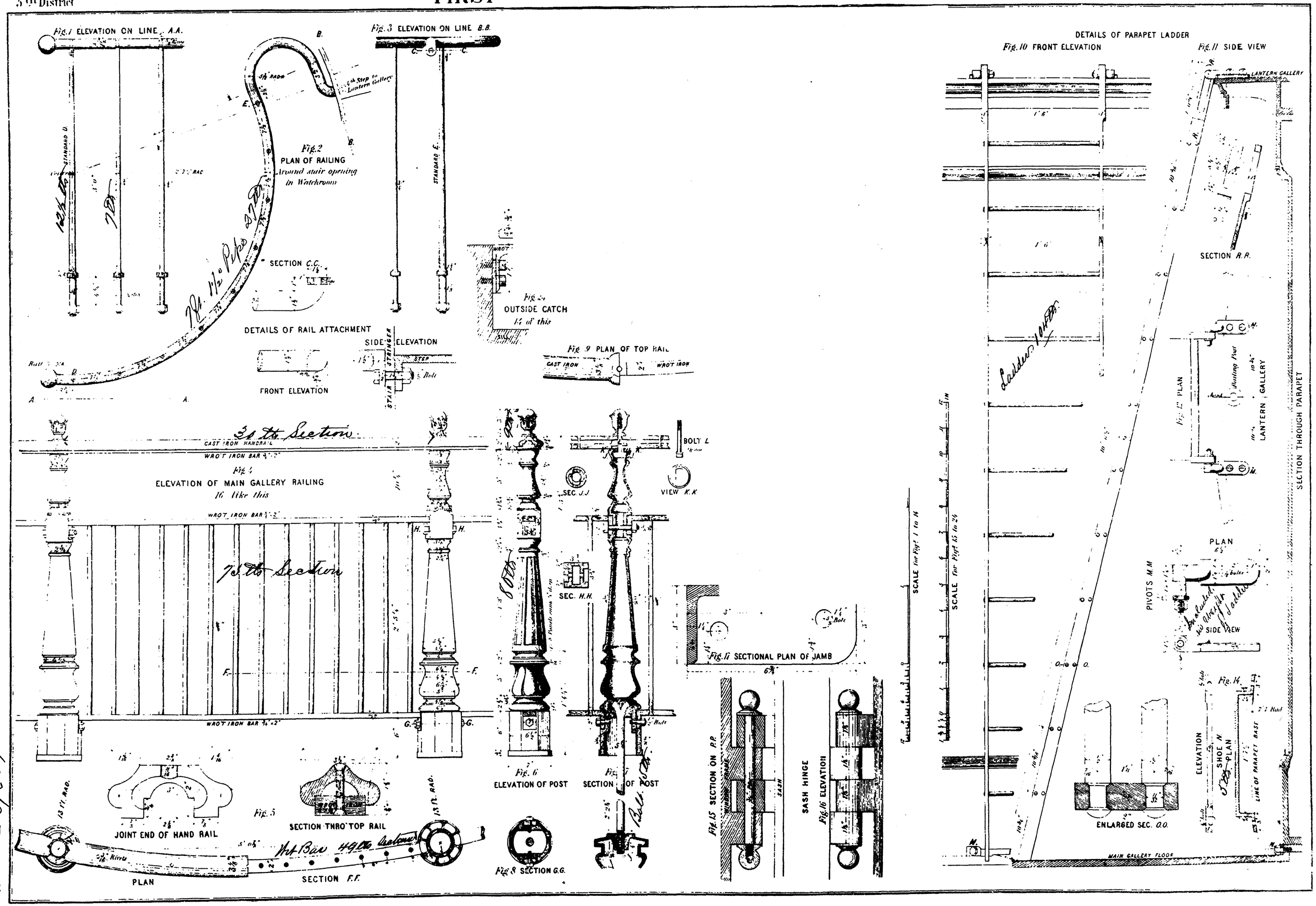

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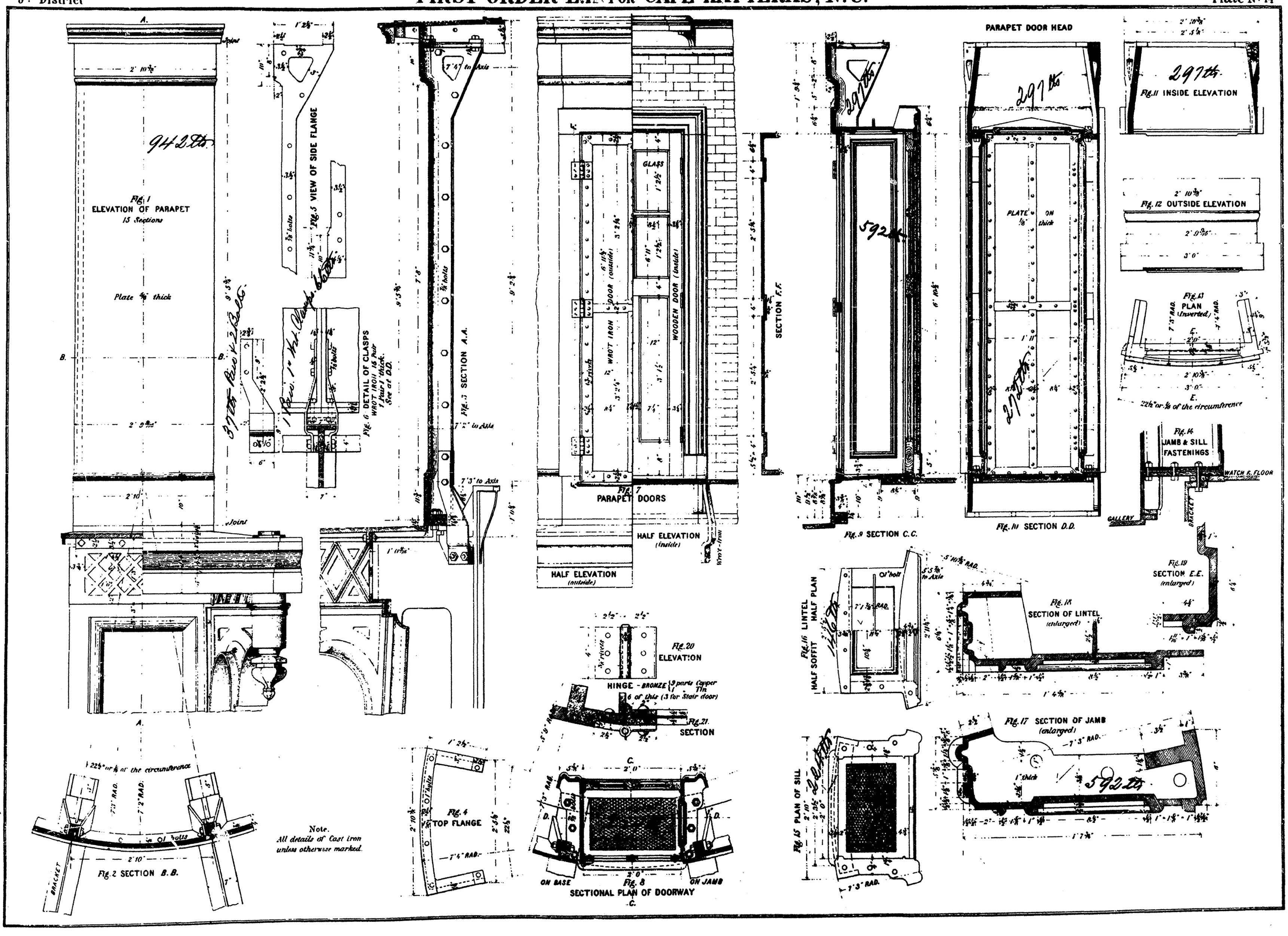

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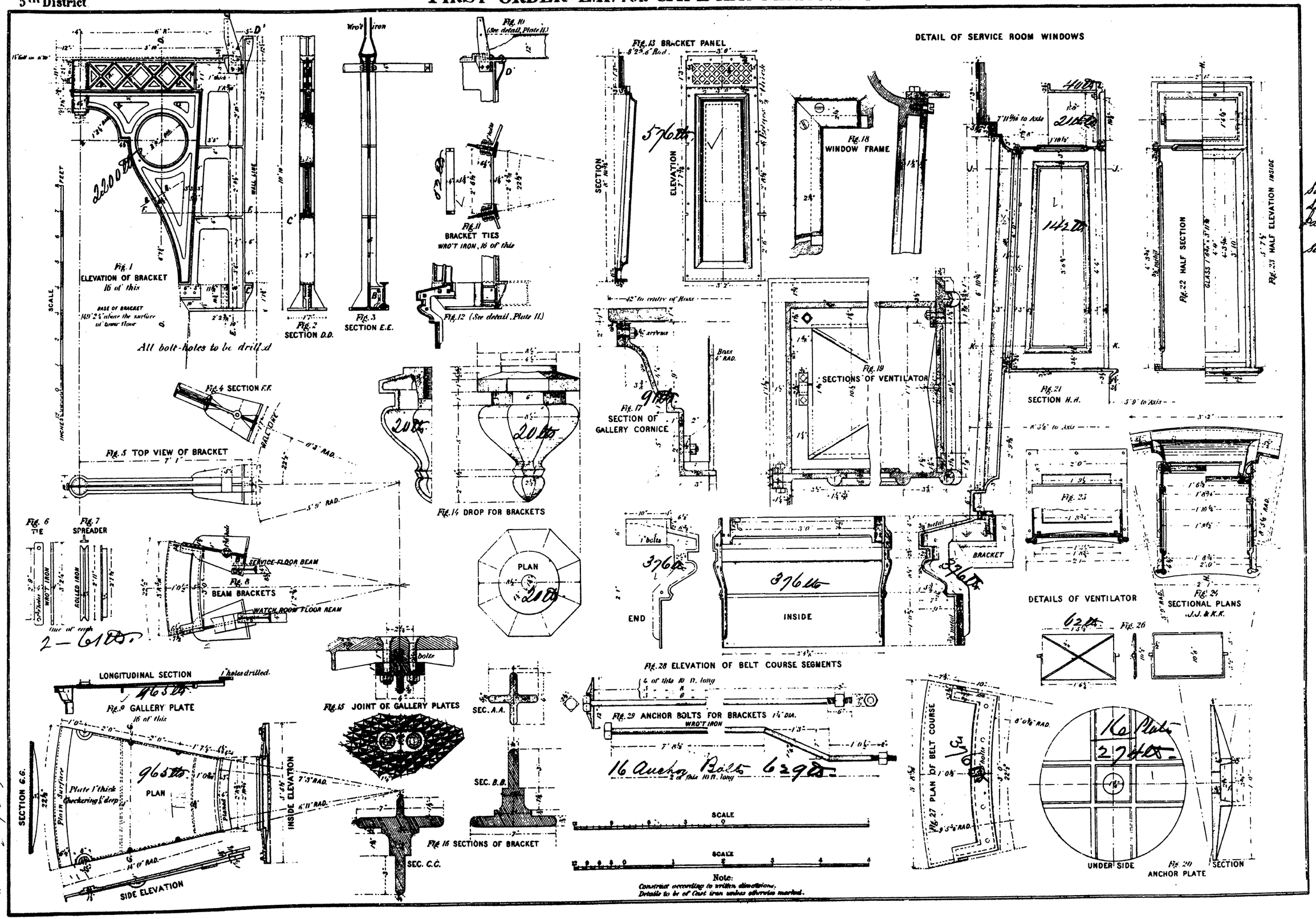

Soffit 66 lbs.
Sill 133 lbs.
Jambs 142 lbs.
" 142 lbs.
Strips 23 lbs.

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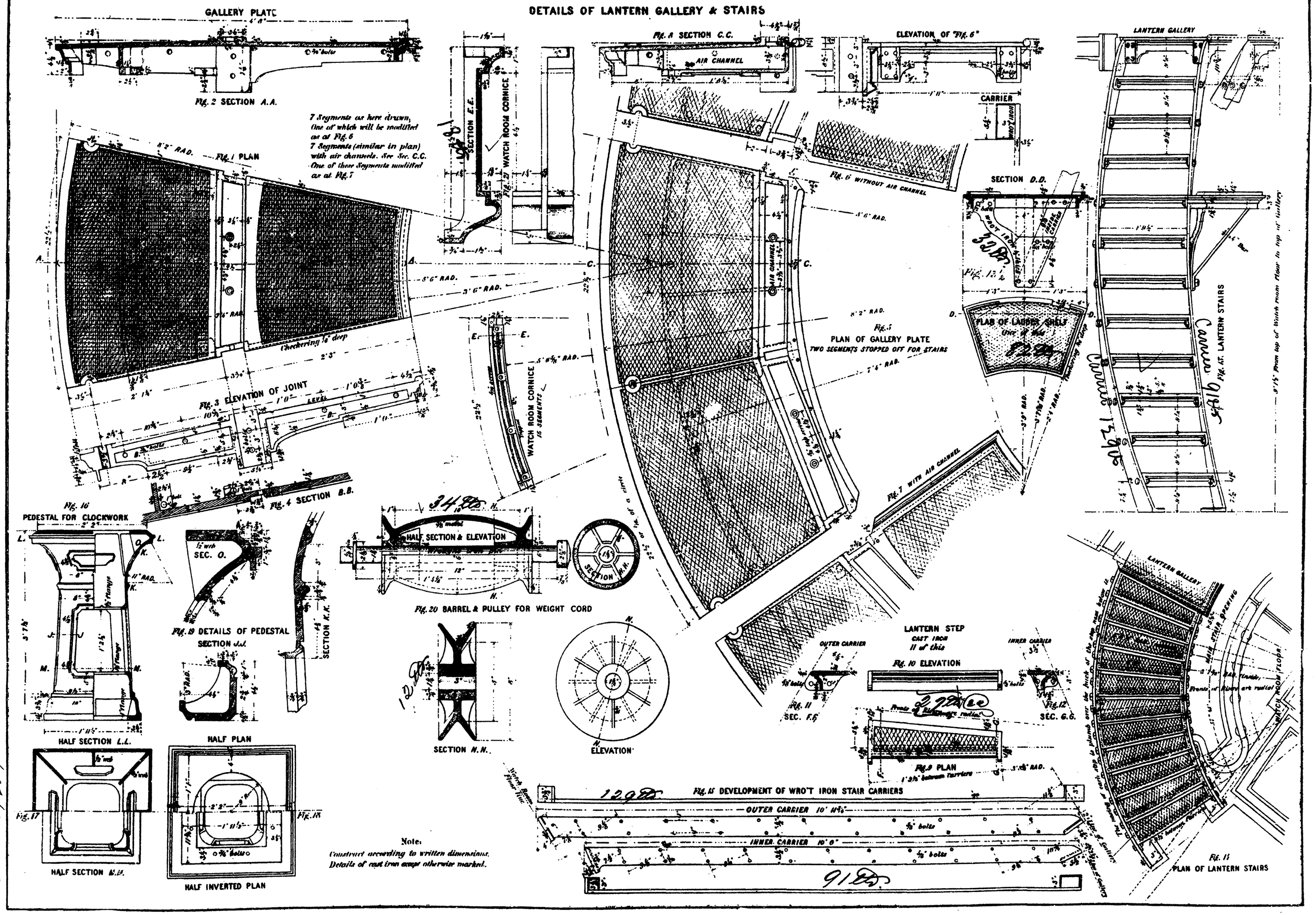
FIRST ORDER L.H. FOR CAPE HATTERAS, N.C.

DETAILS OF LANTERN GALLERY & STAIRS



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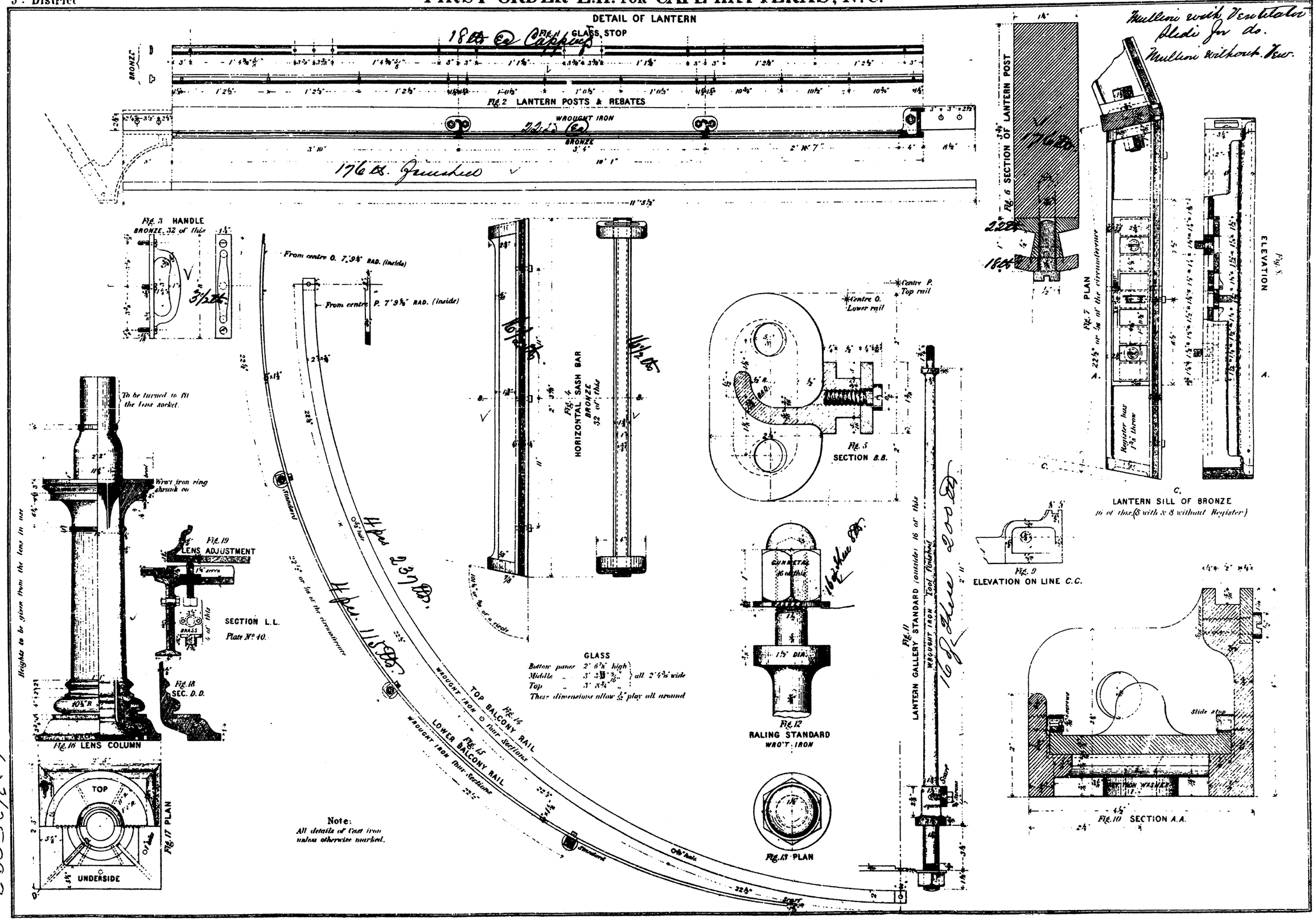
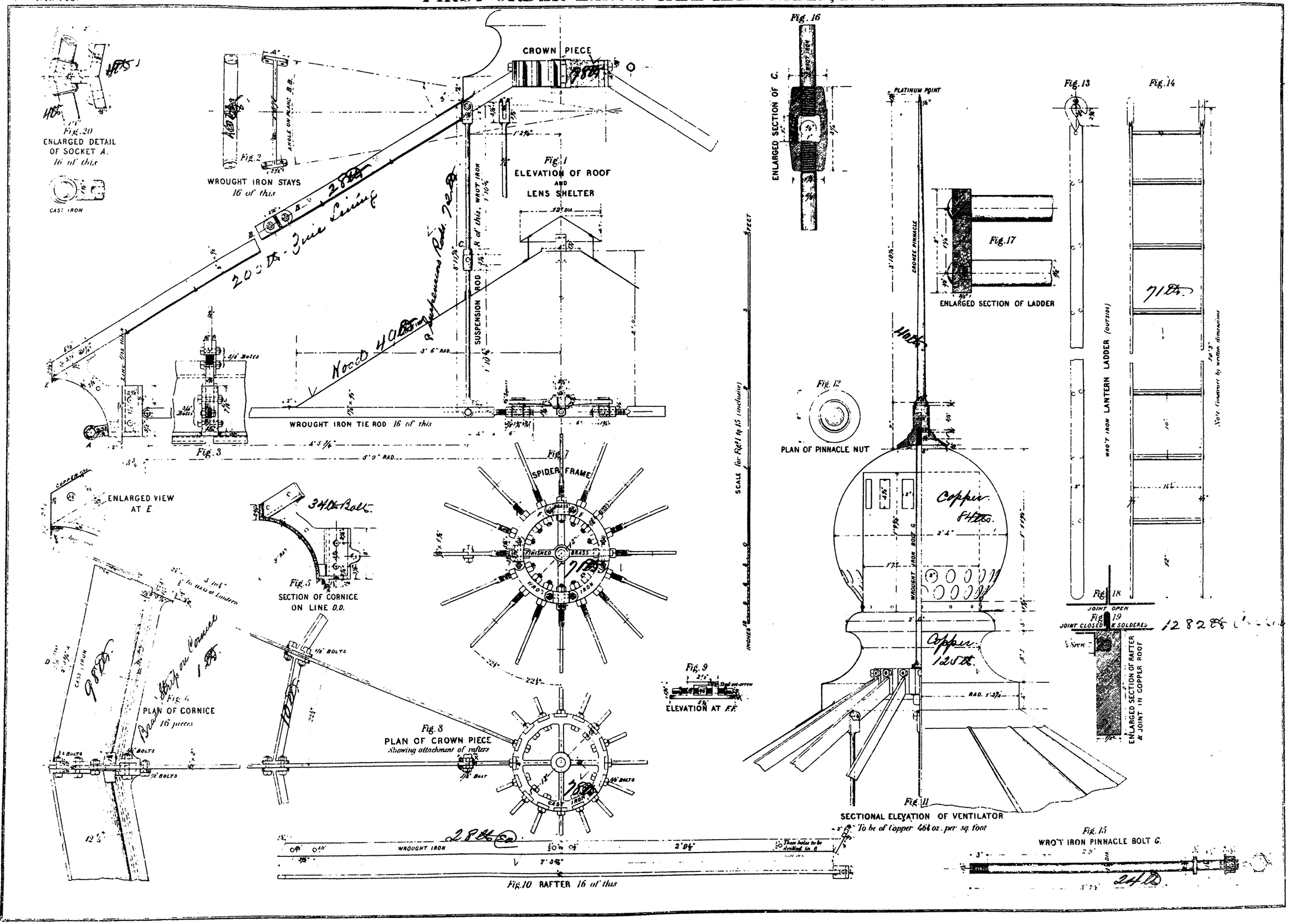
FIRST ORDER L.H. FOR CAPE HATTERAS, N.C.



Note:
All details of Cast iron unless otherwise marked.

FIRST ORDER L.H. FOR CAPE HATTERAS, N.C.



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Appendix G

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Appendix G: 2015 Vertical Access Monitoring Recommendations

Diebolt, Kent (Vertical Access) "Cape Hatteras Lighthouse." *Site Visit Report.* Completed for NPS HPTC. November 11, 2015.

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Site Visit Report

Cape Hatteras Lighthouse

Vertical Access LLC
PO Box 4135
Ithaca, NY 14852

T: 607 257 4049 / F: 607 257 2129

November 11, 2015

To: Rebecca Cybularz, Thomas Vitanza, Jami Lanier & Nelson Pendleton

From: Kent Diebolt

Introduction:

Vertical Access (VA) was contacted in March of 2015 by Tom Vitanza and Rebecca Cybularz from the National Park Service Historic Preservation Training Center (HPTC) to assist with budget pricing the installation of an electronic crack monitoring system at the Cape Hatteras Lighthouse (CAHA). At that time, VA was provided with the 95% Draft *Condition Assessment Report*, authored by Joseph K. Oppermann, AIA and Craig Bennett, PE, dated August, 2014. I reviewed their report with recommendations made and an October, 2015 site visit was arranged, in order to evaluate the structure for installation of a structural monitoring system.

Kent Diebolt, the author of this Report, was on site October 14th, 2015 and met with both Jami Lanier and Nelson Pendleton for about 5 hours. We had a close look at the base of the lighthouse and made a tour to the top, including the watch room balcony and lantern gallery. It should be noted that the entire structure, exclusive of the granite plinth had been painted in 2014, subsequent to site visits made by Mssrs. Opperman and Bennett.

The recently-applied paint coating largely obscures most of the cracks on the exterior of the brick, making it very difficult to see the cracks, even at grade,

where direct observation was possible. In many cases, the paint film appears to span minor "hairline" cracks where these were observed at grade. High-definition digital photos were also taken on October 14th by the author using a monopod for stabilization, and despite digital magnification of these (20 megapixel) images, it proved difficult to locate the existing cracks identified in the Oppermann and Bennett report. Therefore, it appears that previously observed cracks were either filled and/or spanned by the newly applied paint coating. If the latter is the case, then these cracks must be quite fine.

Cracks through granite blocks forming the base or plinth may portend ongoing damage resulting from brick swelling due to hysterisis but could also be the result of settlement onto the new brick foundation subsequent to the move.

Observations made at the interior of the lighthouse included some vertical cracking masonry distress due to corrosion where iron floor-framing members are let into the brickwork. Distress due to corroding cast iron window enclosures and vents at the ninth level landing, just below the watch room balcony is also evident. An area of particular concern is the badly corroded railing at the lantern gallery. In addition to safety concerns, damage to the deck plates is imminent, due to pack rusting of the dowels pocketed into and clamped between adjacent plates.

In our experience with a number of tall, slender masonry structures such as lighthouses, industrial brick chimneys and obelisks, there is always a degree of vertical cracking, due to the effects of thermal expansion and contraction. This is considered "normal" and no realistic cure or treatment exists that will stop these from recurring. The vertical cracking mentioned at the interior and exterior of the lighthouse mentioned in the Oppermann and Bennett report is likely of little concern but warrants periodic observation with documentation of existing conditions over time. This should begin when the presently fresh paint coating begins to weather, allowing for more dependable remote visual observations from grade. At some point in time, however, it will be useful to make direct measurements of these faults at specific locations, allowing for comparative direct measurements of crack width and length over time.

Observations and recommendations:

Ongoing remote visual surveys of exterior is likely inadequate for monitoring development of cracking. Maximum crack widths and lengths should be measured directly, rather than observed from the ground.

Since the Oppermann and Bennett report indicates that there is "no significant deviation from vertical alignment" we question the need to measure the degree of verticality or plumbness by a surveyor. Furthermore, it may be possible to determine this more readily from the inside, by simply dropping a heavy plumb bob into a bucket of water for damping and taking measurements to the interior, straight walls, rather than by surveying the tapering exterior. This is a measurement that could be made on an annual basis, from a number of baseline points at each of the landings if results demonstrate the need.

Sixty inches of brick in-filled foundation between the 4' reinforced concrete foundation and the bottom of the granite plinth has been noted. However, there is no discussion of this as a potential contributor to observed recent (post 1999) cracking of stone units in the plinth.

Given that the brick portion of the foundation was laid up incrementally in towers under the lighthouse once it was in place, some degree of settling into the new brick foundation is to be anticipated. As the supporting beams were removed, the brick foundation was filled in between individual piers. This (by necessity) order of work makes it unlikely that the load was uniformly shared by the new brick foundation. If this is the case, then that settlement should have ceased by now, as the load was re-distributed. Monitoring of plinth cracking certainly supports the monitoring recommendation in order to answer the question of whether settlement is ongoing or not. Problems with the the new (1999) reinforced concrete slab foundation seems unlikely 15 years after construction.

The Oppermann and Bennett report notes historic (1999) cracks but does not compare the width of these to the 1999 cracks because that information does not exist. Even though replicated measurement of cracks without reference points is a fraught exercise, some indication of whether movement is ongoing or not may be revealed.

I did not observe any obvious signs of misalignment of adjacent plinth stones. However, if this condition existed, it would certainly indicate foundation problems, if combined with cracking. Cracking through units and joints is not uncommon and may not be particularly concerning if the condition is not ongoing.

Examination of the below grade brick infill and concrete mat is both expensive and may be unwarranted, without significant indication of distress. Likewise, testing of foundation brick to determine "related growth characteristics" also seems unwarranted unless ongoing distress is indicated.

However, it would be useful to refer to the brick specification and testing that surely took place in 1999.

Examination of "all ferrous metals buried in the masonry" also seems unwarranted, though a sampling should be considered. My suggestion is that a corrosion engineer with preservation experience should be hired to take a look and consider the feasibility of installation of a cathodic protection system for iron embedded in the masonry walls.

The railing at the lantern catwalk is relatively recent work and is constructed entirely of rolled, mild steel with significant rust-jacking. There is no doubt that this badly corroded railing should be completely replaced as soon as possible, before damage to the cast iron plates that they "pocket" into fail due to rust-jacking. In my opinion, this represents the most imminent and pressing threat to the fabric of the lighthouse. Failure to replace the railing in a timely manner in more appropriate materials will undoubtedly incur vastly increased future costs for repairs to the cast iron decking.

Recommendations:

A thorough, "hands-on" investigation with careful documentation of crack location, width and length in 3-5 years or more, after the paint erodes a bit, is recommended.

A corrosion engineer with preservation experience should be engaged to evaluate ongoing deterioration of iron elements, especially landing framing that is pocketed into masonry walls and cast iron window surrounds that penetrate into the walls.

Problems with long-term monitoring systems are legion. In the case of CAHA, the public also has access to the base of the lighthouse so tampering or vandalism are both issues that must be considered. In the case of electronic systems, these must be maintained and the likelihood of the numerous parts of a system of this sort surviving the entire 3-5 year term are unlikely. Furthermore, there can also be problems associated with "signal drift" and damage from electrical surges or outages.

Our feeling is that a longer-term, low-tech approach will reveal whether the cracking observed at the plinth is ongoing or not and will adequately inform next steps, if warranted.

A monitoring program for the plinth should be designed with a 3-5 year duration, as this appears to be a slow-moving problem, if it is a problem at all. There are several relatively "low-tech" approaches that can be taken:

A) Using epoxy putty, install class microscope slides across a sampling of cracks representing "new" (2015) as well as cracks observed and recorded in 1999. While this approach is expeditious, with very low costs associated, results are not necessarily conclusive.

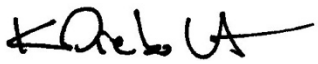
B) Similarly, install Avongard ™ crack monitors. If these are monitored on a regular basis by competent observers, this may be all it takes to answer the question of whether there is ongoing movement at the foundation or plinth.

C) As suggested in the 2014 Report, install non-ferrous bolts or threaded studs in the threads of Hilti "drop-In" anchors. These can be installed in pairs, across a sampling of cracks, similar to A and B, above. Using a calibrated digital caliper, the distance between these bolts should be measured and recorded on a monthly or quarterly basis, for 3-5 years. Similar to B), above, analysis of these results will indicate whether a more sophisticated electronic monitoring system is required, be it traditional vibrating wire technology or more up-to-date (and more robust) fiber optic equipment.

Finally, if water intrusion at the plinth is a concern, CAHA should also consider installation of lead “Tees” into skyward-facing joints in the granite plinth. This will reduce water infiltration into the foundations system and while not authentic, is a good idea, functionally.

I appreciate the opportunity to be of assistance and remain available to discuss or develop these thoughts further.

Sincerely,



Kent Diebolt
Founding Partner, Vertical Access LLC

Appendix H

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Appendix H: 1989 HABS Documentation

Historic American Building Survey, National Park Service, United States Department of the Interior. "Cape Hatteras Lighthouse, Point of Cape Hatteras, access road from Rt. 12, Cape Hatteras National Seashore, Buxton, Dare County, North Carolina." Survey No. NC-357. *Photographs and Written Historical and Descriptive Data*. 1989. Accessed at http://www.loc.gov/item/nc0432/ on December 16, 2015.

Historic American Building Survey, National Park Service, United States Department of the Interior. "Cape Hatteras Lighthouse." Survey No. NC-357. *13 Sheets*. 1989. NPS DSC eTIC No. CAHA 603 25004.

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CAPE HATTERAS LIGHTHOUSE
Point of Cape Hatteras,
access road from Rt. 12
Cape Hatteras National Seashore
Buxton
Dare County
North Carolina

HABS NO. NC-357

HABS
NC,
28-BUXT,
1-

PHOTOGRAPHS AND

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

REDUCED COPIES OF MEASURED DRAWINGS

Historic American Buildings Survey
National Park Service
Department of the Interior
Washington, D.C. 20013-7127

HABS
NC,
28-BUXT,
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HISTORIC AMERICAN BUILDINGS SURVEY

CAPE HATTERAS LIGHTHOUSE

HABS NO. NC-357

Location: Point of Cape Hatteras, access road from Rt. 12, Cape Hatteras National Seashore, Buxton, Dare County, North Carolina.

Present Owner: National Park Service, under the direction of the Superintendent, Cape Hatteras National Seashore, Rt. 1, Box 675, Manteo, North Carolina.

Present Occupant: The United States Coast Guard operates and maintains the light; the lighthouse is otherwise uninhabited and inaccessible.

Present Use: The lighthouse is still used as such, although it is automated and now inaccessible to the public.

Significance: Cape Hatteras Lighthouse is significant as an important aid to the navigation of the Atlantic Coast. The Diamond Shoals which extend up to ten miles out from Cape Hatteras, coupled with the Gulf Stream currents, earned this area its reputation as the "graveyard of the Atlantic." A lighthouse was first established here in 1803, heightened in 1853. It was replaced with the current lighthouse in 1869-70. The current light tower, painted with black and white spirals for recognition during the day, is the tallest brick light tower in the United States.

PART I. HISTORICAL INFORMATION

A. Physical History:

1. Date of erection: 1869-1870. According to the Annual Report of the Light-House Board for 1868-1870, "a working party was organized in October, 1868, and on the 19th started for Cape Hatteras to commence operations, arriving there on the 4th November..." They began with the construction of quarters, etc. for the workmen, a wharf where building materials were delivered and a tram railway (1/2 miles long) from the wharf to the site. Construction of the lighthouse began in 1869. It was finished in 1870 when, "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."

2. Architect: The lighthouse was designed by the Light-House Board, 5th District. The original drawings "First Order L.H. for Cape Hatteras, N.C.," engraved and printed by Julius Bien of New York are still extant. There are eighteen plates; elevations, sectionals and details. There is no architect or delineator's name, only the 5th district and a date, 1869. The drawings do, however, comply at least in general, with the "Specifications for a First Order Light-House (Brick Tower)" prepared at the office of the Light-House Board, October 1861.

3. Original and subsequent owners: The actual site of the lighthouse, a lot of four acres, was deeded to the United States of America from William Jennett et al in February of 1801. A larger, adjoining lot of approximately 40 acres was deed from Pharoah Farrow. The National Park Service acquired ownership of the lighthouse when it was temporarily abandoned in 1935. When the light was reinstated in 1950, the Coast Guard then gained ownership and operation of the lighting equipment while the National Park Service maintains the tower, as part of the Hatteras National Seashore.

4. Builder, contractor, suppliers: The lighthouse was erected by the Light-House Board, using its own crew. It fell under the supervision of the Engineer's Office for the 5th Lighthouse District, Baltimore, Maryland, under the direction of Major George B. Nicholson, Assistant Engineer. The Superintendent of construction on site was Dexter Stetson. Nicholas M. Smith of Baltimore was awarded the contract for the red brick (of which it took 1,250,000 to build the lighthouse). The stone used for the foundation and steps was supplied by Beattie, Dawson & Company of Niantic, Connecticut. Bartlett, Robbins & Company supplied the metal work. The shipping and delivery of materials was provided by Lennox and Burgess of Philadelphia.

5. Original plans and construction: As mentioned, the original drawings still exist. A team of HABS architects, who recently re-drew the lighthouse, discovered that the existing light tower-as built-matches the 1869 drawings almost identically. Discrepancies seem to occur only where later changes were made. Reports included in the Annual Reports of the Lighthouse Board (1868-1870) outline the construction process as follows:

1868 "An appropriation is available for rebuilding this important light-house, and the requisite

materials therefore are now being collected. Contracts for the brick have been entered into, a tram road of the Peteler pattern has been contracted for, and every necessary preparation will be made looking to the commencement of work early in the season."

"Under the act of Congress approved March 3, 1868, appropriating the sum of $80,000 for rebuilding the lighthouse, a working party was organized in October 1868 and on the 19th started for Cape Hatteras to commence operations, arriving there on the 4th November. Suitable buildings for workmen's quarters and mess-room were erected; a blacksmith shop built; a house in which to store cement and other perishable materials put up; two derricks erected; a wharf built on the south side of the island, distant 1-1/4 miles from the station.... Also, a tram railway.... laid from the wharf to the lighthouse, upon which to transport materials. These preparations having been made, and the materials beginning to arrive, work has commenced upon the foundations of the new tower."

1869 "The operations on this edifice progressed rapidly and satisfactorily under the direction of the engineer of the district from the date of the last annual report until the 16th of June. By this time 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 the iron stairway in position, and their landings arched. The work thus far has been of the most thorough character, the iron work finished by the contractors is excellent, and the brick laid in the most substantial manner, each brick being completely embraced in the best kind of cement mortar, and each course as it was laid brought truly to the batter and leveled. The cement and brick used were of unexceptionable quality...."

"The tower having attained the above height of 153-1/2 feet, a delay occurred in procuring the iron work of the capital, and as nothing more could be done without it, it was order on the 16th of June to suspend operations and withdraw the force until such time as the castings would be ready.... The capital finally advanced toward

completion at the workshops, the steamer Tulip was dispatched on the 10th September with a party in order to make preparations for the reception and setting up of the iron work.... on the 27th they left under tow of the steam tender Tulip, via the Albemarle and Chesapeake Canal, for the work."

"On the 25th of September, 1869, the ninth course of granite quoins was set up and backed with brick, as was also a portion of the tenth course."

"During November extensive repairs were made to the old dwelling, and a large quantity of filling in of sand and soil was made in a slough surrounding the house."

"January 30, brick work reached a height of 32 feet above the main floor."

"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 28, a height of 147 feet from the ground or 141 feet above the main floor was reached."

"June 16, the brick work was leveled up to a height of 153-1/2 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 suspended as was above related."

"The iron casing of the watch-room and the lantern are now being placed, and it is expected that the entire height (180 feet to focal plane) will be completed before the ensuing winter. This will be the highest brick light-house tower in the world."

"This important Light-house was well advance towards completion at the date of the 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 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, the lower part (projected against the foliage in the rear) painted white; all the iron work of the stairs, lantern, etc. painted, and the tower inclosed in a neat iron fence.... In addition to the finishing of the new tower, a brick dwelling for the principal keeper of the Light-station was built and inclosed in a neat picket-fence. The above completed the work at this station."

6. Alterations and additions: Few alterations have been made to the Hatteras Lighthouse, beyond general repairs. The first significant change was made in 1873 when the tower was repainted with alternating black and white spiral bands. This was done to make the tower more distinctive, and therefore a better "day mark" for ships traveling the coast. In the spring of 1879 the tower was struck by lightning, creating cracks in the masonry of the tower. It was determined by the Light-House Board that this was due to an imperfect connection of the iron-work of the tower with the earth. Thus, a metal rod connecting the iron work of the tower with an iron disk sunk in the ground was added.

The most significant changes were made in light apparatus. In 1913 the original lamps were replaced with incandescent oil vapor lamp. In 1934, the rotating system of weights was replaced with electricity and a time switch to turn the light on and off was added. The light was removed from the tower in 1935-1950 and a light was exhibited from a steel skeletal tower built for that purpose. A new light device was installed in the tower when the light was returned to it in 1950. Finally, the current system was installed in 1972. The lighthouse, once open to the public, has been closed due to needed repairs, including the extensive repair/replacement of the cast-iron gallery.

B. Historical Context:

The current Cape Hatteras Lighthouse was built in 1869-1870 to replace the original light tower built in 1802 and raised in 1853. Both were constructed to guide ships through this dangerous passage known as the "graveyard of the Atlantic." It is the shallow Diamond Shoals, which extend more than ten miles out along the Cape, combined with the Gulf Stream currents which make navigation

through this area so difficult. Because of the distance at which a light need be seen, the Cape Hatteras Lighthouse is the tallest brick tower in the United States, displaying a first order Fresnel lens.

The existence of lighthouses can be traced back to the ancient Egyptians. From the earliest times, ways have been sought to guide ships past dangerous shoals, reefs, etc. and safely into harbor. The earliest lighthouse in America was the Boston Harbor lighthouse built in 1716. It was followed by ten other colonial era lighthouse built along the Atlantic coastline. These early lights were erected and maintained by the local people, generally the merchants and ship captains who had the most to gain. They were often financed through "light dues," a fee charged by weight to ships entering the harbor.

The importance to the American economy of shipping, and of the importing and exporting of goods was recognized by the newly formed United States government. Thus, in 1789 an act was passed in Congress conveying all responsibility for aids to navigation to the central government. Administration fell to the Treasury Department with various different officials supervising. In 1802, a year before the first Cape Hatteras Lighthouse was built, responsibility passed to Albert Gallatin, Secretary of the Treasury. Plans for the construction of the Cape Hatteras Lighthouse began in 1797 when Congress authorized construction of a lighthouse at this site. The light was not exhibited until 1803, still making it one of the country's earliest lighthouses.

The lighthouse served as a great help to the navigation of Cape Hatteras--when it could be seen. For decades complaints that the light was not continuously lit, or that it could not be seen from a great enough distance, were heard. Thus, the light was refitted to extend its range in 1835, and again in 1838 and 1840! Still, complaints continued, such as a letter from Lt. David Porter, commander of the U.S. Mail Steamer, the *Georgia* in July 1851 which stated, "Hatteras Light, the most important on our coast, and, without doubt, the worst light in the world....The first nine trips I made I never saw the Hatteras light at all.... When I did see it I could not tell it from a steamers light, except a steamers lights are much brighter.... It is all important that Hatteras be provided with a revolving light of great intensity, and the light be raised fifteen feet higher than at present" (National Archives, Clippings file RG

26, Box 10). Finally, in 1853 the tower was heightened, and in 1854 a First Order Fresnel Lens was installed (Henry Leparte of Paris, maker). The new lens was also equipped with a gear-and-weight mechanism that enabled it to rotate. A keeper's dwelling was also built at this time.

The Fresnel Lens revolutionized lighthouse technology. The lens consisted of an assemblage of prisms around a single lamp. The prisms both magnified and refracted the light outward, greatly increasing the intensity of the light. The lens varied in size from first-being the largest-to sixth order (with a three-and-a-half order), depending on the range required. It was named for its inventor, Augustin Fresnel had been perfected in 1822 in France. It soon became the standard in Europe but was resisted by the Fifth Auditor of the Treasury, Stephen Pleasonton, who oversaw the administration of Light-Houses. Finally, in 1851 a board of specialists was appointed to investigate, among other things related to aids to navigation, the Fresnel Lens. It was determined to be superior, and slowly replaced all existing lens by the mid 1860s.

The Fresnel Lens greatly improved navigation past Cape Hatteras. Problems with repairs to the light tower, however, began to emerge. In 1864 a request for funds to repair the tower was submitted. Upon investigation, the Light-House Board determined the existing tower was not worth repairing but that a new tower should be erected instead. Congress appropriated $80,000 for a new tower in 1868, and construction on the current lighthouse finally began (Annual Reports of the Lighthouse Board, National Archives).

In October of 1868 a work-crew was organized by Asst. Engineer George B. Nicholson of the Light-house Board, Engineer's Office for the Fifth Lighthouse District in Baltimore, Maryland. The crew arrived on the 4th of November and construction began under the direction of Dexter Stetson, the superintendent on site (See Part I., A.5. Original plans and construction for an account of the construction process). The lighthouse was completed and the lens installed in December of 1870. On December 16th the light was exhibited from the new tower for the first time. In February, the old tower was blown-up and destroyed. A new keepers house was also undertaken at this time, begun in November of 1870 and completed in early 1871. The tower received its distinctive spiral black & white bands, which identify it by day, in 1873 (Ibid.).

A number of changes in the status of the lighthouse occurred in the 1930s. First, in 1934, the Fresnel Lens was removed and an automated light was installed. No longer would it be necessary to have keepers on site to tend to the constant maintenance of the light and the structures on site. Automation, in fact, marked the end of an era in Lighthouse history. The Hatteras Lighthouse once required three keepers (and their families), and now all that was necessary was periodic checking of the bulb by the Coast Guard. Also during the 1930s the tower itself was threatened. Erosion, which had been a problem at Cape Hatteras from the time that the first tower was construction, became increasingly worse during the 1930s. Interlocking steel-pile groins were installed in an attempt to hold the beach. Erosion continued, however, and fear that it would topple the tower led to the erection of a skeletal tower on which the automated light was placed, in 1936. The lighthouse structure was then turned over to the National Park Service. By 1950, erosion had subsided enough that a light was returned to the lighthouse. The lighthouse and associated buildings (two keepers dwellings and oil house) remain the property of the National Park Service and are now part of the larger Hatteras National Seashore. The light, which is still exhibited from the tower, is maintained by the Coast Guard.

PART II. ARCHITECTURAL INFORMATION

A. General Statement:

1. Architectural character: Lighthouses come in a variety of shapes and sizes depending on the site and the necessary visibility of the light. They epitomize the form follows function rule. The height of the tower depends on the height of the site and the distance the light must travel. The size of the lantern depends on the size of the lens and the mechanisms needed, etc. They are necessarily functional architecture--although often decorative too--designed for a specific purpose. The functional aspect along with the fact that the Light-House Board prepared all drawings and specifications lead to standardization of designs. The design of the Cape Hatteras lighthouse, with its tall, conical brick tower, was outlined in a 1861 Light-House Board publication "Specifications for a First Order Brick Tower." It was, in fact, one of a number of similar towers constructed in the southeast region of the country during the 1870s. The Hatteras Lighthouse is however, distinguished by its

extreme height, being the tallest in the country, and by its black and white spiral paint.

2. Condition of the fabric: Although the light tower appears sound, it is in need of extensive repairs to its structural iron work, particularly in the gallery.

B. Description of Exterior:

1. Overall dimensions: The Cape Hatteras Lighthouse is a conical brick tower, resting an octagonal brick foundation with stone quoining with an iron lantern atop it. The tower rises 208'-0" from the bottom of the foundation to the peak of the lantern. The focal plane of the light is 191'-0" above the mean high water mark. The diameter of the tower at the base just above the foundation is 32'-5-1/2", and at the top below the lantern it is 17'-2."

2. Foundation: The tower rests on an octagonal base of brick and stone with stone quoining. At the ground, are four courses of rock-faced ashlar block which decrease in diameter as the rise up in a pyramid effect. This same ashlar block is used as quoining at each of the eight corners of the octagon. Stone steps flanked with walls leads to the entry.

The actual foundation is referred to as a "floating foundation" of criss-crossing yellow pine timbers buried in a pit and immersed in seawater to preserve them. When the construction crew commenced to dig the foundation it was discovered that the sand here was so compact that the piles could not be made to penetrate more than six feet and a sounding rod no farther then nine feet. This information was relayed to Gen. J.H. Simpson, Engr. 5th Lighthouse Dist. by the Superintendent of construction on site at Hatteras, Dexter Stetson. Simpson's reply ordered them to dispense with the piling and instead lay two layers of six inch timbers at that depth (in the manner shown in the drawings). Thus, a double "grillage" platform served as the foundation (National Archives, RG 26, Clippings file, Cape Hatteras).

3. Walls: The walls are of brick, approximately 1,250,000 of them. There is an outer wall (octagonal on the first level and cylindrical above) and a cylindrical inner wall with connecting walls between, like the spokes of a wheel. The brick walls were covered with a cement wash to protect it from the effects of the weather. Originally, the upper portion of the tower (that part

projecting against the sky) was painted red, and the lower portion (projecting against the foliage) was painted white. Since 1873 it has been painted with alternating black and white spiral bands as are currently seen. The paint served as a "day mark" for identification during daylight hours.

4. Structural system, framing: The tower is constructed of a system of load-bearing brick walls, consisting of inner and outer walls with twelve spoke-like connecting walls. The interior spiral stairway is of cast and wrought iron as is the lantern, gallery and supporting brackets at the top of the tower.

5. Stoops, galleries: A small stoop with stone steps and side walls of ashlar block is located at the entryway, at the north elevation of the lighthouse. The tower is topped by a cast-iron gallery onto which is mounted the lantern which houses the light. The gallery is supported all around by large iron brackets, in a circle and drop pendant motif. A decorative cast-iron railing runs around the perimeter of the gallery deck. It consists of a lower rail of bars with an upper rail where every other rail from below extends, broken by a large turned newels at evenly spaced intervals. The deck of the gallery is also cast iron.

6. Openings:

a. Doorways and doors: The doorway at the base of the tower is recessed, and has a classical stone frontispiece, with a projecting pediment supported by console brackets. There is a pair of heavy metal doors, divided by plain rails into three panels each. There is a louvered vent over the door.

b. Windows: Three small casement windows, aligned down the front over the entry, and four to the rear, light the spiralling stairway. They are rectangular and are recessed into the walls. The original drawings show the windows with pedimented windowheads, but these do not currently appear on the lighthouse.

7. Lantern: The tower is topped by a rounded lantern which houses the light. It is completely enclosed with large glass panels, one of which opens up for entry onto the upper gallery. It is topped by a finial-like ball and rod, which serves as a lightning rod.

C. Description of Interior:

1. Interior plan: Entering into the base of the lighthouse there are four recessed spaces (north, south, east and west). The entry occupies the north space and the other have in them benches on which oil tanks to fuel the light once sat. The interior contains a spiralling, cast iron stairway which runs along the interior wall. At the base of the stair, upon entering the lighthouse, is located the light well where the weights that operated the mechanism that turned the light descended (Cookoo clock principle). The stair is broken by seven semi-circular landings, each lit by a window. At the top of the stair is a doorway into the base of the lantern where the gears of the mechanism that rotated the original light can be found. A small stairway leads to the inside of the lantern itself.

2. Stairways: A cast iron, spiral stairway runs along the interior wall, winding its way up to the top of the tower. The decorative, cast iron steps consist of treads cast in a small, raised diamond pattern (for traction), and risers with two cut-outs, flanked with a simple rosette. At the corner of each step a narrow, rounded baluster rises to the handrail, terminated at the base with a decoratively cast newel post. The stairway is broken by semi-circular landings which are set at intervals proceeding the formation of a full circle of steps, or each individual flight. According to the standards set by the Light-house Board for a first order brick tower, the stairway was to be made of cast iron with the step height to a uniform gauge of eight inches. Each flight was to be temporarily erected and fitted together at the workshop (pgs. 5-6).

3. Flooring: The floor at the base of the lighthouse is presumably concrete covered with black and white linoleum tile in a checkerboard pattern. The floors of the landings are cast iron. As specified in the Light-house Boards standards, "Each landing is formed of two cast-iron plates one inch thick, partly (im)bedded in the brickwork and partly resting on a cast-iron girder, whose ends are also secured in the brickwork of the cylinder" (p. 6). The landings are also covered with black and white linoleum tiles.

4. Wall and ceiling finish: The interior walls are brick, painted white.

5. Openings:

a. Doorways and doors: The front doorway into the tower is recessed into the thick walls, forming a small hall or vestibule. There is a doorway at the top of the tower, into the lantern/watchroom area.

b. Windows: There are small, rectangularly-shaped casement windows at each landing. They are recessed into the thick walls and have single panel, cast iron reveals, and a panel on the wall above the window. The narrow surrounds are also cast iron and have a half-round bead along the inner edge (extending up into the panel above) and a smaller bead along the outer edge.

6. Mechanical Equipment: Although the Fresnel lens has been removed and the light has been automated, the mechanical system of gears which rotated the light remains. The gears were set into motion by 150 lbs. of weights which hung from the gears under the lens at the top of the tower, down 160 feet through the tower into the pit at the base of the tower. It was regulated by a round pedestal clock mounted on the inside of the pedestal which supported the lens. Once wound, the clock would run for fifteen hours before the keeper would have to reset it.

D. Site:

1. General setting and orientation: The lighthouse sits at the tip of Cape Hatteras, an elbow-like projection to the southern end of the Outer Banks peninsula. West of the peninsula is the Pamlico Sound beyond which is mainland North Carolina. To the east is the vast Atlantic Ocean where lies the dangerous Diamond Shoals which make the lighthouse necessary. The entry faces north, though the light rotates a full 360 degrees, thus facing all directions. When erected in 1870, the tower stood 1,500 feet from the shore. Due to erosion, the tower now sits dangerously close to the shore, raising questions as to ways to move, or otherwise save, the lighthouse. A short wall once encircled the lighthouse. Due to the shifting sand, only the top of this wall is now visible. A wooden fence encircles the lighthouse in the same location.

2. Historical setting and orientation: The original lighthouse, constructed in 1803, sat just south of the

current lighthouse. According to an 1869 account, "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" (National Archives, Clippings file, RG 26, Box 10). The foundations of the original tower were once visible but have since eroded into the ocean. Much of the beach that was here at the time that both the original tower and the current 1870 tower were built has also eroded away, despite the belief at the time the new tower was built that the new site would resolve this problem. According to the 1869 account of the site, "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.... 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" (Ibid.).

3. Outbuildings: Located just north of the lighthouse, along the edge of the fence line, is the oil house. This small brick structure was built in 1890 to store cans of oil used as fuel for the light. It is rectangularly shaped with a gable front roof. There is a doorway on the west facing elevation and window openings to either side (boarded over on the south side and ventilated on the north). Also on the site are two keepers dwellings (see NC-357-A and NC-357-B). A number of storage and other outbuildings were once located on this site as well. Automation of the light which meant that oil, keepers, etc. were no longer needed, made these buildings obsolete and they have since been removed.

PART III. SOURCES OF INFORMATION

A. Original Architectural Drawings: The original drawings executed by the Light-House Board still exist, and are located at the National Archives, Washington, D.C. They consist of 18 "plates" or sheets (plate 13 is missing however), showing the elevation, sectional, foundation and plinth, stairway, landings, windows and doors, the lantern, iron work and extensive details (see Field Records for copy). The plates were executed by J. Bien, Lithographer of New York.

B. Annotated Bibliography:

1. Primary and unpublished sources:

Cape Hatteras Lighthouse. "Clippings File, Cape Hatteras Lighthouse," National Archives, RG 26. File

includes abstracts form the annual reports of the Lighthouse Board, misc. letters regarding the construction of the foundation, newspaper article, draft of an unsigned, undated history, request for proposals for the original lighthouse (with specifications) and a type written copy of "History of Cape Hatteras Light Station, N.C.," by Eldrige, ca. 1950.

Hatch, Charles E., Jr. and J. Fred Roush. "Cape Hatteras National Seashore, North Carolina; Historical Management Plan. Washington, D.C.: National Park Service, Department of the Interior, Division of History, Office of Archeology and Historic Preservation, June 1968. This report discusses the main historical themes, and a statement of historical significance for the lighthouse, providing historical context.

Light-House Board. Annual Report of the Light-House Board, 1868 Washington, D.C.: Government Printing Office, 1868. The Annual Reports of the Light-House Board (available at the National Archives) came out every year, beginning with its conception in 1852. 1868 is the first year that the current lighthouse is discussed, in terms of planning and appropriations. Other important years include: 1869 discussing site, construction progress (foundation, etc), 1870 discussing brick work and progress, 1871- progress, brick keepers dwelling, 1873- black & white spiral paint job, 1876, 1880 & 1881- repairs, 1887- oil house, 1888 & 1892- repairs and changes to keeper's dwellings.

_____. "Index to Light-House Board Correspondence, Cape Hatteras, National Archives, RG 26, NNRC 13E. An index to the correspondence between the Lighthouse Board and anyone having business with them regarding the light, including the keepers, district engineers and superintendent, contractors, etc. The individual slips for each letter gives date, writer, and a statement of the business discussed. Many of the actual records were lost. However, much can be learned from the index alone. The index for the Hatteras Lighthouse covers the years 1853-1897.

Machemehl, Jerry L. and MTMA Design Group. "Cape Hatteras Lighthouse; Study and Report prepared for the National Park Service, U.S. Department of the

Interior, Denver Service Center, December 1980. Basically a technical report of the efforts to stabilize both the lighthouse and the surround shoreline, with a brief historical background.

National Park Service, Hatteras National Seashore (Headquarters, Manteo, North Carolina). "Building Records- Cape Hatteras Light Station." Individual building data forms, records of repairs, 1982-87.

_____. "Cape Hatteras Lighthouse, Restoration Project." A log book of structural analysis and recommendations for the restoration and preservation of the lighthouse.

Tech-Fab, Inc. "Report on Complete Inspection of the Cape Hatteras Lighthouse." Raleigh, N.C.: Tech-Fab, Inc., 24 January 1980. A report on the existing conditions, and the structural systems of the lighthouse, with photographs.

United States Coast Guard. "U.S.C.G. Lighthouse Sites, Bald Head (NC No. 1)- Cape Lookout (NC No. 10),National Archives, RG 26, box #165, file for Cape Hatteras, NC No. 9. This file includes information of the acquisition of the both the lighthouse site and the park property- Hatteras National Seashore. Included are the deeds (going back to 1795), letters, etc. regarding the condemnation proceedings for the park; a "Questionnaire covering Real Estate owned by the United States" describing the lighthouse property, dated October 30, 1929; blueprint drawing, "Cape Hatteras Light Station, Plat of new reservation" approved May 21 1936 by L.M. Hopkins, 5th dist. Superintendent. It compares the focal plane of the lighthouse with the temporary skeletal tower which housed the light from 1936-1950; "Site Lt. House at Cape Hatteras, N.C." a site plan for the original light, dated Nov. 29th 1854.

_____. "Records of the United States Coast Guard, Description of Light Stations, 1876-1938," National Archives RG 26, Box 8. Contains a full description of the Cape Hatteras Light Station, dated June 9, 1927. The description includes the lighthouse- is materials, specifications, characteristics; information regarding the lantern and illuminating apparatus; fog signal; keepers dwellings, etc.

Whitehouse, Frank E. "A field Investigation of Cape Hatteras Lighthouse, Buxton, North Carolina." F.E. Whitehouse, Assoc. Engineer, March 15-18, 1937. A typed report on file at the Park Headquarters office, Manteo discussing the present conditions of the lighthouse, descriptions, and suggestions for the necessary repair work.

2. Primary and unpublished sources, general lighthouse history:

United States Life-Saving Service. Regulations for the Government of the Life-Saving Service of the United States. Washington, D.C.: Government Printing Office, 1899. Information on the management of the service and duties of the various branches such as the Superintendents of Construction, Inspectors, District Superintendents, keepers, etc. (Smithsonian).

United States Light-house Board. Management of Lens Apparatus and Lamps. Washington, D.C.: Government Printing Office, 18??. Descriptions, composition, measurements, etc. of lenses, and lamps, and directions for their use. (Library of Congress).

_____. Specifications for a Double-Dwelling for the Keepers of First Order Lights. Prepared at the Office of the Light-House Board, Treasury Department. Washington, D.C.: Government Printing Office, 1862. Excellent source for knowing how the light-house keepers house should have been constructed and appear when finished. It gives all the specifications for everything from excavation and foundation to door and window frames, plastering, etc. (Smithsonian).

_____. Specifications for a First Order Lighthouse, (BrickTower). Prepared at the Office of the Light-House Board, Treasury Department. Washington, D.C.: Government Printing Office, 1861. Excellent source for determining how the lighthouse was constructed and how it should have looked when completed. It gives all the specifications, from excavation and foundation to interior finish and iron work, including the housing of the light itself (Library of Congress).

United States Light-House Establishment. Instructions to Light-House and Light Vessel Keepers of the United States, 2nd ed. By Authority of the United States Light-House Board. Washington, D.C.: Government Printing Office, 1856. Describes the duties of the light-keeper and directions for executing those duties, including the care of lights and other equipment, use of lard and mineral oils, sirens and fog signals, etc., directions for painting, allowances for provisions, tables of salaries and diagrams of lighting equipment.

_____. Instructions to Keepers. July, 1881.

_____. Instructions to Light-Keepers and Masters of Light-House Vessels. 1902.

3. Secondary and Published Sources- Hatteras Lighthouse:

Committee on Options for Preserving the Cape Hatteras Lighthouse. "Saving Cape Hatteras Lighthouse from the Sea." Washington, D.C.: National Academy Press, 1988. Recommendations for saving the lighthouse, mostly regarding the problems connected with the site and its physical environment. Also includes some historical background.

Holland, Ross, Jr. America's Lighthouses; An Illustrated History. New York: Dover Publication, Inc., 1972. This is a good general history of lighthouses in America. It discusses the history of the administration of lighthouses, the light apparatus, keepers life, etc. It includes a brief section on the hatteras lighthouse, pgs. 112-116 with a photograph. This is a good source for the historical context.

_____. Cape Hatteras Light Station, North Carolina. Washington, D.C.: U.S. Department of the Interior, National Park Service, Office of Archeology and Historic Preservation, 1968. This report is considered the source for the history of the Hatteras Lighthouse. It was conducted as a historic structures report for the NPS and includes a complete history of the lighthouse, and the site, going back to the construction of the original lighthouse that this one replaced. It covers everything from congressional appropriations to repairs, fuel oils to keepers.

_____. Great American Lighthouses. Washington, D.C.: The Preservation Press (Great American Places Series), 1989. Gives a brief overall history of various types of lighthouses, of lights and other aids to navigation, keepers and the administration of lighthouses. The bulk of the book is a region by region survey of lighthouses, including the Hatteras light. This is a good sources for comparing lighthouse types for contextual purposes.

_____. Keepers Dwelling: Cape Hatteras Light Station. Washington, D.C.: U.S. Department of the Interior, National Park Service, Office of Archeology and Historic Preservation, 1 December 1968. This was also a historic structures reports conducted of the NPS. It regards the principal keepers dwelling on site and included historical and architectural data as well as the existing conditions (with photographs and copies of original drawings).

Norcross, Kathy. "The Hatteras Lighthouse Keeper's Son." Mid-Atlantic Country, May 1986, pg. 34- . Recollections of Rany Jennette, son of the last lightkeeper of the Hatteras Lighthouse. It gives insight into the life of a keeper during the early 20th century.

Picketts, Alfred C. "Hatteras the Stormy." Los Angles Times, April 10, 1910, p. 460. The problems in navigation of the area of the Hatteras Lighthouse, and the legends associated with.

Stick, David. The Outer Banks of North Carolina, 1584-1958. Chapel Hill, North Carolina: University of North Carolina Press, 1958. Provides historical context for the area, giving a general history with a brief account of the history of the lighthouse, pgs. 288-291. Discusses the legends, storms and shipwrecks.

Whitehouse, Frank E. "Sentinel of the Atlantic Graveyard." The Regional Review, Vol. III, No. 2, August 1939, pgs. 11-16. This article gives a brief history of the lighthouse and a description of the light apparatus, and discusses the dangers on navigating along the Outer Banks.

4. Secondary and Published Sources- General Lighthouse History:

Alexander, John Henry. Experiments on Mr. Babbage's Method of Distinguishing Light-Houses, Reported to the Committee of the United States Light-House Board. Washington, D.C.: Government Printing Office, 1861. Discusses methods for distinguishing lighthouse lights by means of periodical occulations which allow the ship captain to positively identify lights.

Heap, David P. Ancient and Modern Lighthouses. Boston: Ticknor & Company, 1889. Informative chapter on the "Characteristics of Light Houses" including lighting and lenses, painting of lighthouses, etc. Also a brief history of the U.S. Light House Board.

Hyde, Charles K. The Northern Lights; Lighthouses of the Upper Great Lakes. Lansing, Mich.: Two Peninsula Press, 1986. Although this book does not cover east coast lighthouses, it has a chapter on lighthouse automation and abandonment of lighthouses during the early 20th century.

Johnson, Arnold Burgess. The modern Lighthouse Service. Washington, D.C.: Government Printing Office, 1889. General history of the Light House Service with information on cost and construction of lighthouses, light vessels, buoys and fog signals, light dues, and service personnel and administration.

Kettle, William R., ed. The Lighthouses of the World and Coast Fog Signals. With introductory remarks by Alexander G. Findlay, F.R.G.S., 36th ed. London: Richard Holmes Laurie, Publisher, 1896. Brief history of lighthouses and light vessels with a larger section discussing the various types of lenses and reflector systems. The bulk of the book is a series of graphs listing all the lighthouses of the world, giving basic information such as size, type. etc.

New York Exhibition Illustrated. "The Fresnel Lens of Dia-Catoptric Illuminating Apparatus for Light Houses." New York: 1853. Period discussion of the Fresnel lens which later (after 1853) became the standard lens for American lighthouses.

Stevenson, Thompson. Lighthouse Construction and Illumination. London & New York: E. & F.N. Spon, 1881. Informative book with description and explanations of the use of lenses (Fresnel, Azimuthal condensing system, etc.; distinctive characteristics of lighthouses (variations on the lights, paint, etc.); statistics of lighthouse apparatus, fog signals.

United States Coast Guard. Guide to Historically Famous Lighthouses in the United States, 1789-1939. Washington, D.C.: Government Printing Office, 1939. Overview of the best known lights.

United States Department of Commerce. "The Bureau of Lighthouses" (George R. Putnam, Commissioner). Washington, D.C.: Government Printing Office, 1926. Three page pamphlet discussing the organization of the Bureau and the purpose of lighthouses, lightships and buoys.

United States Lighthouse Service, compiler. Papers on the Comparative Merits of the Catoptric and Dioptric of Catadioptric Systems of Lighthouse Illumination and Other Subjects Relating to Aids to Navigation. Washington, D.C.: Government Printing Office, 1861. Compiled from the British, French and American reports and lighthouse authorities for the use of the U.S. Light-House Establishment Service.

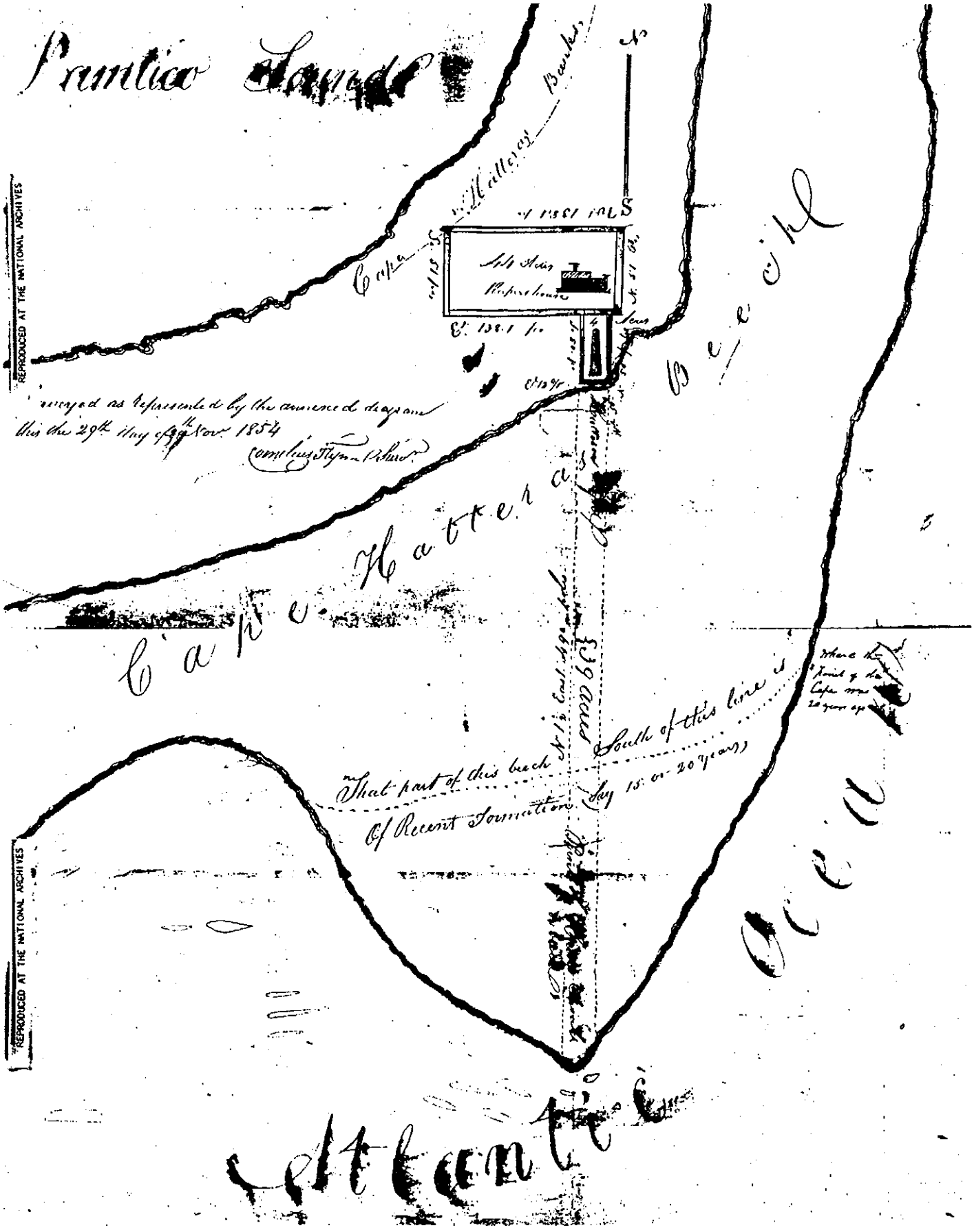
Weiss, George. The Lighthouse Service: Its History, Activities and Organization. Baltimore: The Johns Hopkins Press, 1926. Good reference, gives a historical overview of the lighthouse service and discusses the duties and activities of the service as well as the keepers. Also includes an organizational outline with lists of lighthouse (and ships) in operation in 1926.

Prepared by: Catherine C. Lavoie
Historian
Historic American Buildings Survey
Fall 1989

IV. PROJECT INFORMATION

The documentation of the Hatteras Lighthouse was part of the 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. Drawings were executed by: Frederick J. Lindstrom, Supervisory Architect HABS; Timothy A. Buehner, Architect HABS; Judith E. Collins, Architectural Technician, Auburn University; and Thomas P. Forde, Jr., Architectural Technician, Virginia Polytechnic Institute and State University. Large format photographs were taken by Jack E. Boucher, HABS Photographer. The historical report and bibliography was prepared by HABS Historian, Catherine C. Lavoie. The project was begun in September of 1989.

Figure #1 Site Plan (1854), Cape Hatteras Lighthouse. National Archives, Maps & Drawings Collections (Pickett Street Annex).



REPRODUCED AT THE NATIONAL ARCHIVES

ADDENDUM TO:
CAPE HATTERAS LIGHTHOUSE
Cape Hatteras National Seashore
Point of Cape Hatteras, access road from Route 12
Buxton
Dare County
North Carolina

HABS NC-357
NC,28-BUXT,1-

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HISTORIC AMERICAN BUILDINGS SURVEY
National Park Service
U.S. Department of the Interior
1849 C Street NW
Washington, DC 20240-0001

ADDENDUM TO:
CAPE HATTERAS LIGHTHOUSE
Cape Hatteras National Seashore
Point of Cape Hatteras, access road from Route 12
Buxton
Dare County
North Carolina

HABS NC-357
HABS NC,28-BUXT,1-

COLOR TRANSPARENCIES

HISTORIC AMERICAN BUILDINGS SURVEY
National Park Service
U.S. Department of the Interior
1849 C Street NW
Washington, DC 20240-0001

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.

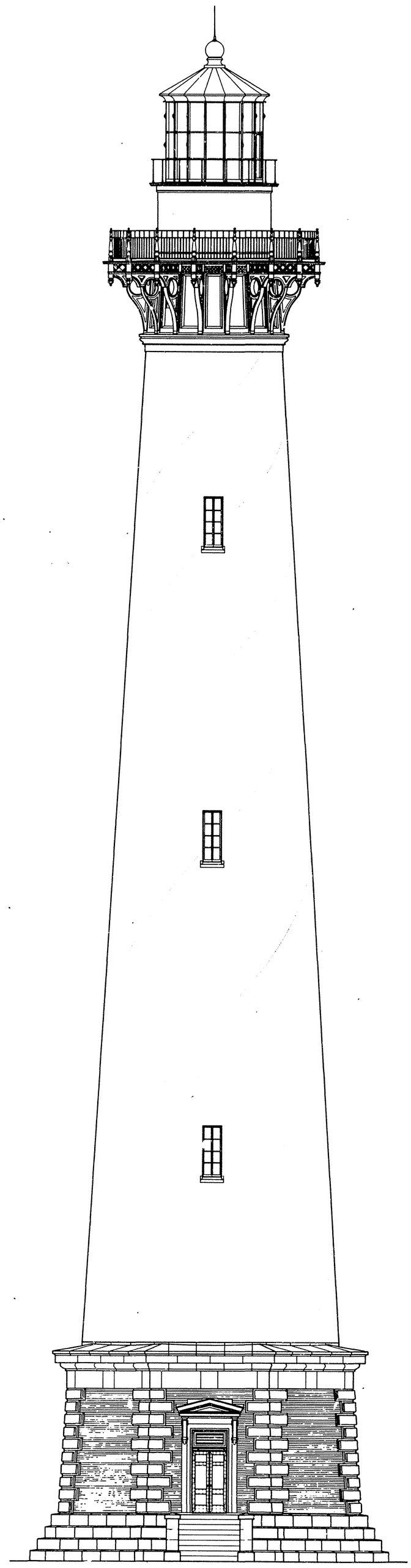
THIS LIGHTTOWER WAS, HOWEVER, INADEQUATE AND POORLY MAINTAINED. REPEATED COMPLAINTS LED TO RECURRENT DISMISSALS OF THE KEEPERS AND EVENTUALLY TO THE TOWER BEING ELEVATED AND REFITTED WITH A FIRST ORDER FRESNEL LENS IN 1853. BY THE 1860s, WITH THE NEED FOR EXTENSIVE REPAIRS, CONGRESS DECIDED TO APPROPRIATE 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., ARCHITECTURAL TECHNICIAN, VIRGINIA POLYTECHNIC INSTITUTE AND STATE 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

FEET 1/8" = 1'-0" 0 1 2 5 10 20
METERS 1:96 0 1 2 3 4 6

DRAWN BY: JUDITH E. COLLINS

CAPE HATTERAS NATIONAL SEASHORE 1989 NATIONAL PARK SERVICE UNITED STATES DEPARTMENT OF THE INTERIOR	NAME AND LOCATION OF STRUCTURE CAPE HATTERAS LIGHTHOUSE BUXTON DARE COUNTY NORTH CAROLINA	SURVEY NO. NC-357	HISTORIC AMERICAN BUILDINGS SURVEY SHEET 1 OF 13 SHEETS	LIBRARY OF CONGRESS INDEX NUMBER

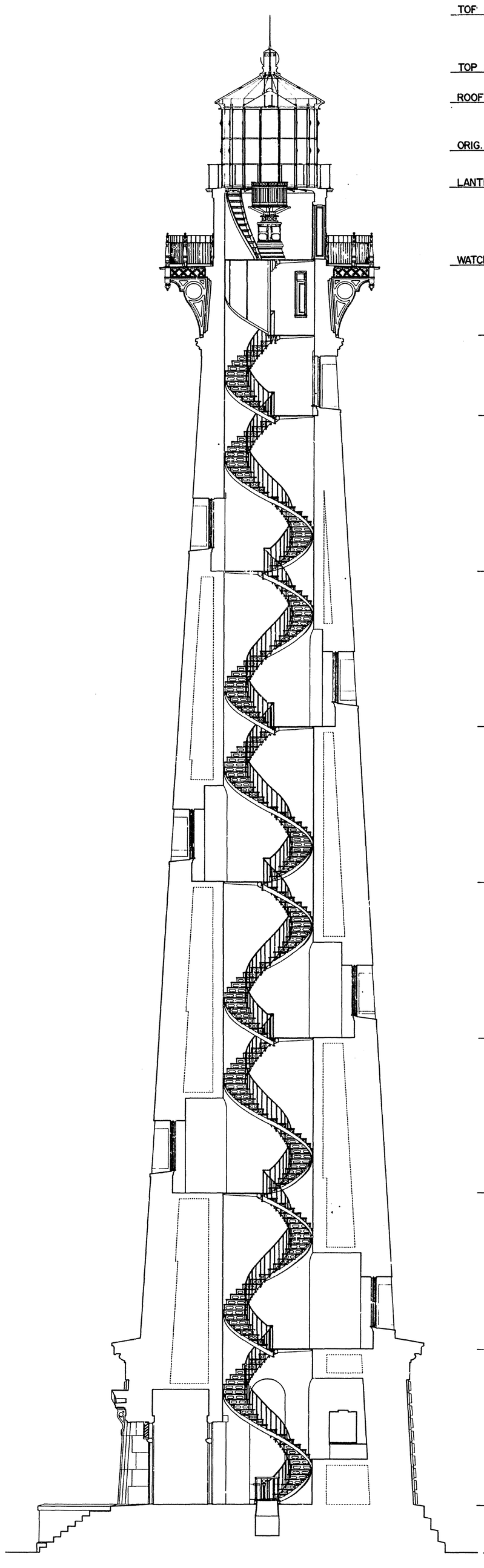
IF REPRODUCED, PLEASE CREDIT HISTORIC AMERICAN BUILDINGS SURVEY, NATIONAL PARK SERVICE, NAME OF DELINEATOR, DATE OF THE DRAWING

403/25004

1-13

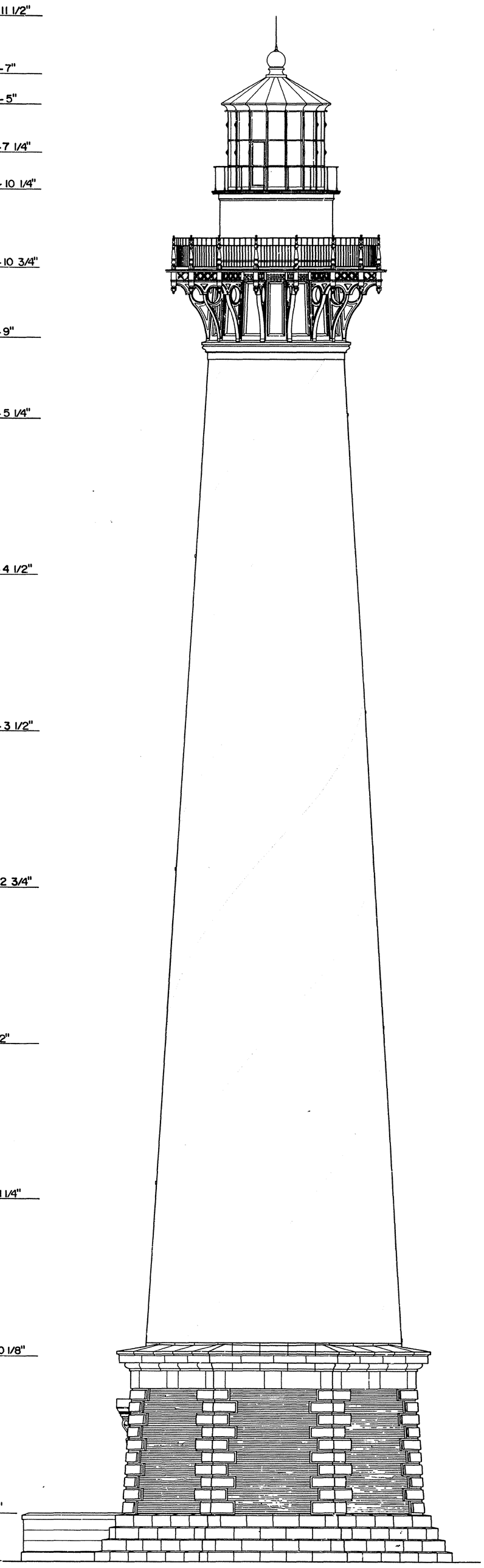
MATERIALS:

BASE: PAINTED BRICK WITH STONE QUOINING AND FRONTISPIECE
DOOR: METAL
TOWER: PAINTED BRICK WITH INTERNAL CAST AND WROUGHT IRON STAIR
WINDOWS: CAST IRON CASEMENT FRAME
LANTERN: CAST AND WROUGHT IRON WITH PLATE GLASS



TOP OF PINNACLE	191'-11 1/2"
TOP OF CROWN	184'-7"
ROOF CORNICE	180'-5"
ORIG. FOCAL PLANE	174'-7 1/4"
LANTERN GALLERY	169'-10 1/4"
WATCH RM. BALCONY	159'-10 3/4"
NINTH LEVEL	150'-9"
EIGHTH LEVEL	140'-5 1/4"
SEVENTH LEVEL	120'-4 1/2"
SIXTH LEVEL	100'-3 1/2"
FIFTH LEVEL	80'-2 3/4"
FOURTH LEVEL	60'-2"
THIRD LEVEL	40'-11 1/4"
SECOND LEVEL	20'-0 1/8"
FIRST LEVEL	0'-0"
GROUND LEVEL	-6'-3"

SECTION (A-A)



EAST ELEVATION

FEET 1/8" = 1'-0" 0 1 2 5 10 20
METERS 1:96 0 1 2 3 4 6

DRAWN BY: JUDITH E. COLLINS

CAPE HATTERAS NATIONAL SEASHORE
1989
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

NAME AND LOCATION OF STRUCTURE
CAPE HATTERAS LIGHTHOUSE
BUXTON DARE COUNTY NORTH CAROLINA

SURVEY NO. NC-357

HISTORIC AMERICAN BUILDINGS SURVEY
SHEET 2 OF 13 SHEETS

LIBRARY OF CONGRESS INDEX NUMBER

IF REPRODUCED, PLEASE CREDIT HISTORIC AMERICAN BUILDINGS SURVEY, NATIONAL PARK SERVICE, NAME OF DELINEATOR, DATE OF THE DRAWING

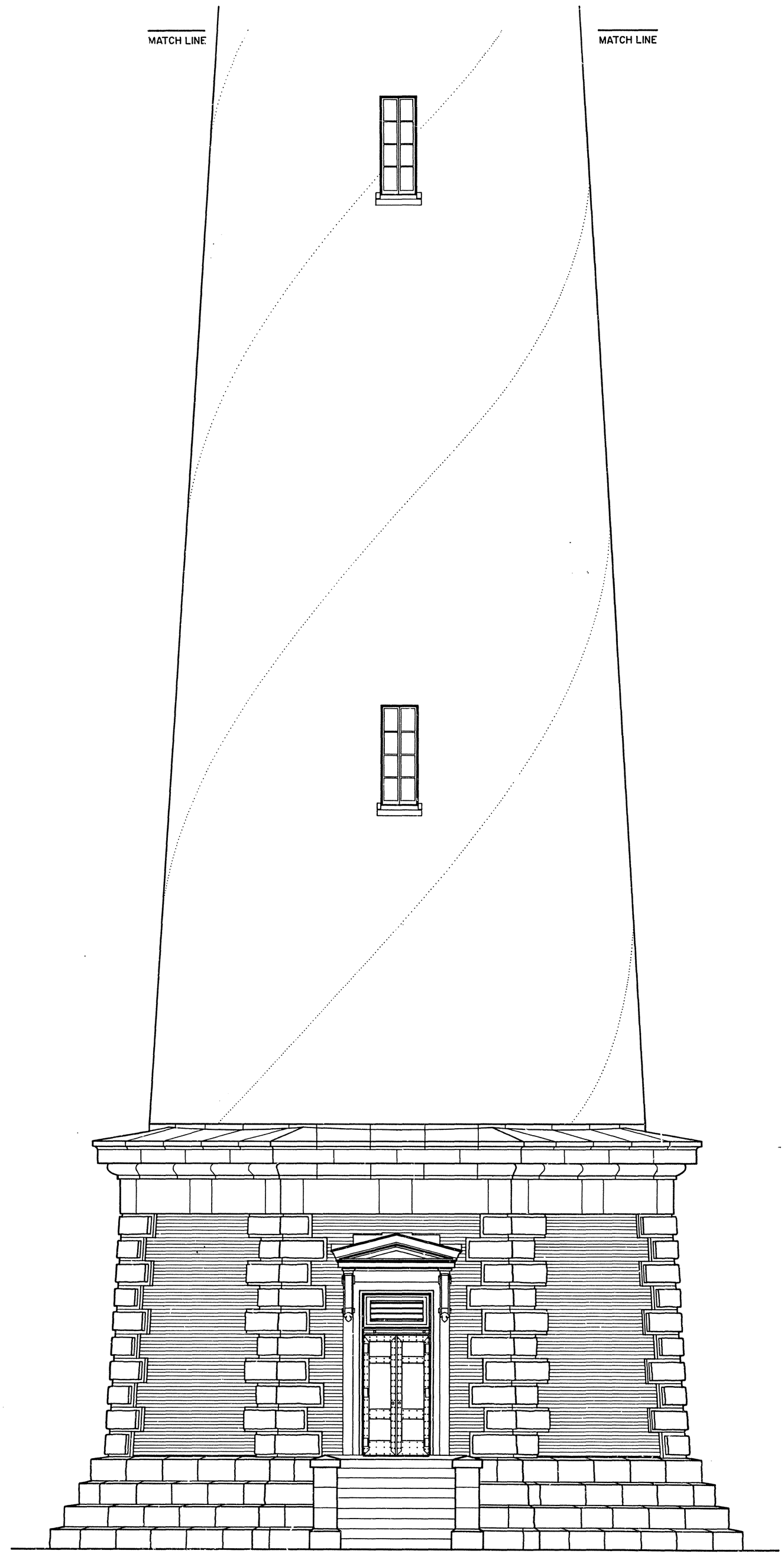
TRIM LINE

TRIM LINE

703/25008

MATERIALS:

BASE: PAINTED BRICK WITH STONE QUOINING AND FRONTISPIECE
DOOR: METAL
TOWER: PAINTED BRICK WITH INTERAL CAST AND WROUGHT IRON STAIR
WINDOWS: CAST IRON CASEMENT FRAME
LANTERN: CAST AND WROUGHT IRON WITH PLATE GLASS



NORTH ELEVATION

BOTTOM HALF

FEET 1/4"=1'-0" 0 1 5 10
METERS 1:48 0 1 2 3

DRAWN BY JUDITH E. COLLINS

CAPE HATTERAS NATIONAL SEASHORE
1989
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

NAME AND LOCATION OF STRUCTURE
CAPE HATTERAS LIGHTHOUSE
BUXTON DARE COUNTY NORTH CAROLINA

SURVEY NO. NC-357

HISTORIC AMERICAN BUILDINGS SURVEY
SHEET 3 OF 13 SHEETS

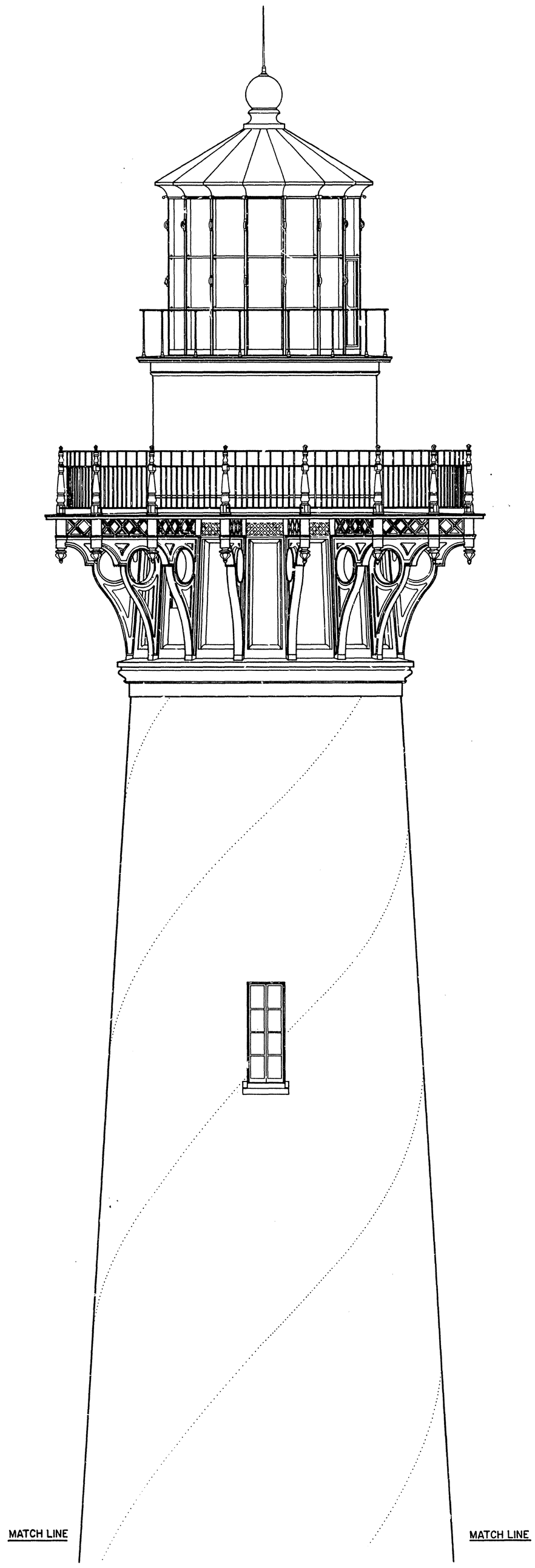
LIBRARY OF CONGRESS INDEX NUMBER

IF REPRODUCED, PLEASE CREDIT HISTORIC AMERICAN BUILDINGS SURVEY, NATIONAL PARK SERVICE, NAME OF DELINEATOR, DATE OF THE DRAWING

G03/25 004

MATERIALS:

BASE: PAINTED BRICK WITH STONE QUOINING AND FRONTISPIECE
DOOR: METAL
TOWER: PAINTED BRICK WITH INTERNAL CAST AND WROUGHT IRON STAIR
WINDOWS: CAST IRON CASEMENT FRAME
LANTERN: CAST AND WROUGHT IRON WITH PLATE GLASS



NORTH ELEVATION
TOP HALF

FEET 1/4"=1'-0" 0 1 5 10
METERS 1:48 0 1 2 3

DRAWN BY: JUDITH E. COLLINS

CAPE HATTERAS NATIONAL SEASHORE
1989
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

NAME AND LOCATION OF STRUCTURE
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HISTORIC AMERICAN BUILDINGS SURVEY
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TRIM LINE

TRIM LINE

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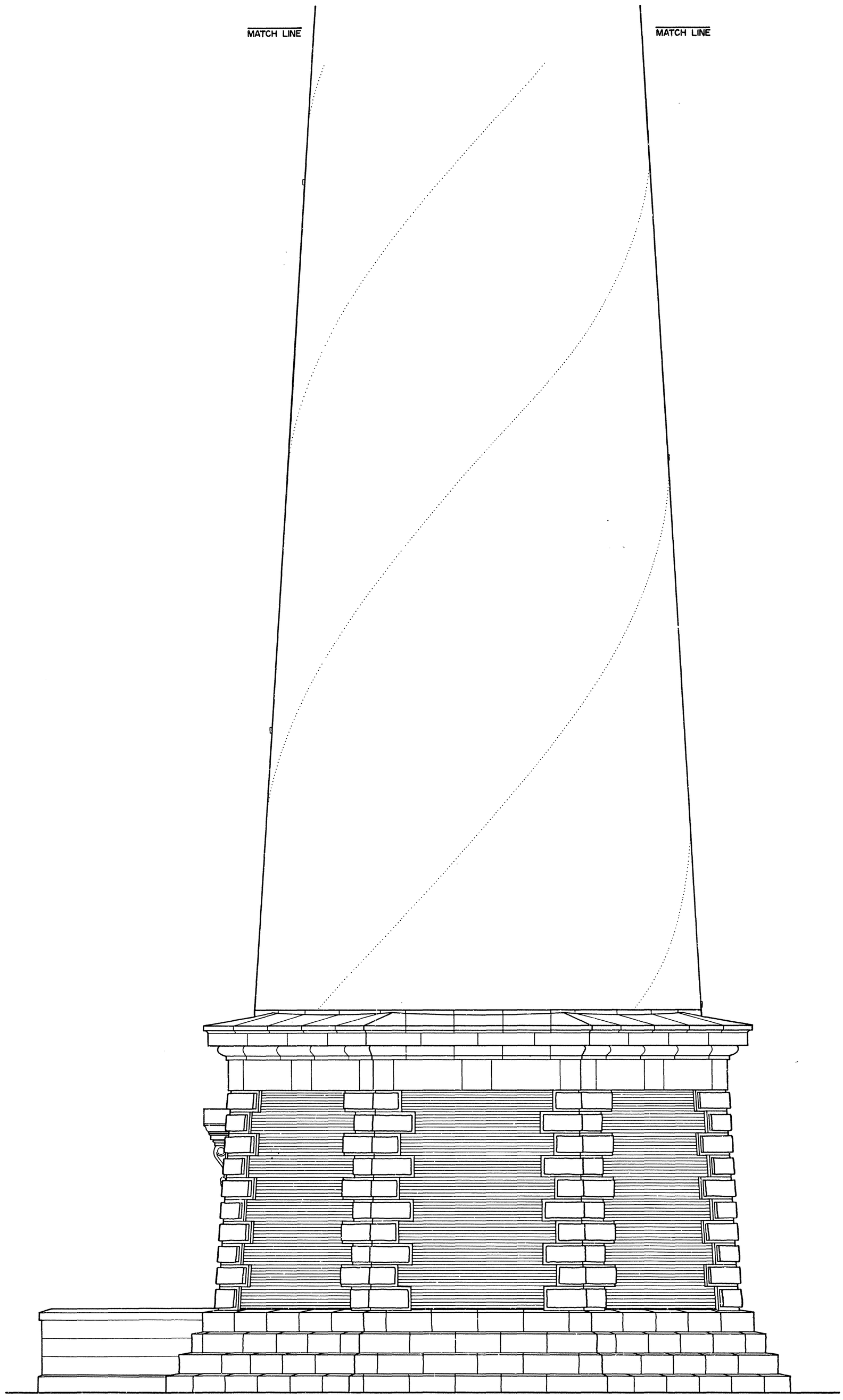
MATERIALS:

BASE: PAINTED BRICK WITH STONE QUOINING AND FRONTISPIECE
DOOR: METAL
TOWER: PAINTED BRICK WITH INTERNAL CAST AND WROUGHT IRON STAIR
WINDOWS: CAST IRON CASEMENT FRAME
LANTERN: CAST AND WROUGHT IRON WITH PLATE GLASS



EAST ELEVATION

BOTTOM HALF

FEET 1/4"=1'-0" 0 1 5 10
METERS 1:48 0 1 2 3

DRAWN BY: JUDITH E. COLLINS

CAPE HATTERAS NATIONAL SEASHORE
1989
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

NAME AND LOCATION OF STRUCTURE
CAPE HATTERAS LIGHTHOUSE
BUXTON DARE COUNTY NORTH CAROLINA

SURVEY NO. NC-357

HISTORIC AMERICAN BUILDINGS SURVEY
SHEET 5 OF 13 SHEETS

LIBRARY OF CONGRESS INDEX NUMBER

IF REPRODUCED, PLEASE CREDIT HISTORIC AMERICAN BUILDINGS SURVEY, NATIONAL PARK SERVICE, NAME OF DELINEATOR, DATE OF THE DRAWING

603/2522

MATERIALS:

BASE:	PAINTED BRICK WITH STONE QUOINING AND FRONTISPIECE
DOOR:	METAL
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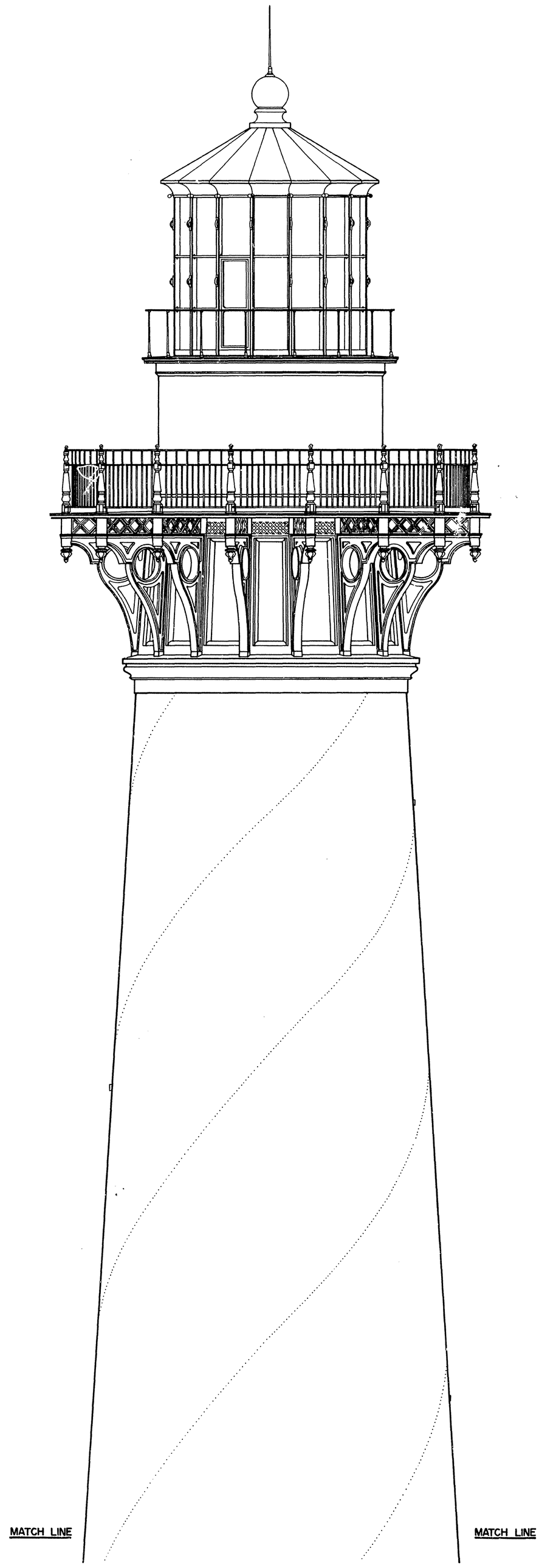
WINDOWS:	CAST IRON CASEMENT FRAME
LANTERN:	CAST AND WROUGHT IRON WITH PLATE GLASS



EAST ELEVATION

TOP HALF

FEET 1/4" = 1'-0" 0 1 5 10

METERS 1:48 0 1 2 3

DRAWN BY: JUDITH E. COLLINS

CAPE HATTERAS NATIONAL SEASHORE
1989
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

NAME AND LOCATION OF STRUCTURE

CAPE HATTERAS LIGHTHOUSE

BUXTON DARE COUNTY NORTH CAROLINA

SURVEY NO. NC-357

HISTORIC AMERICAN BUILDINGS SURVEY
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LIBRARY OF CONGRESS INDEX NUMBER

IF REPRODUCED, PLEASE CREDIT HISTORIC AMERICAN BUILDINGS SURVEY, NATIONAL PARK SERVICE, NAME OF DELINEATOR, DATE OF THE DRAWING

TRIM LINE

TRIM LINE

603/25009

MATERIALS:

BASE: PAINTED BRICK WITH STONE QUOINING AND FRONTISPIECE
DOOR: METAL
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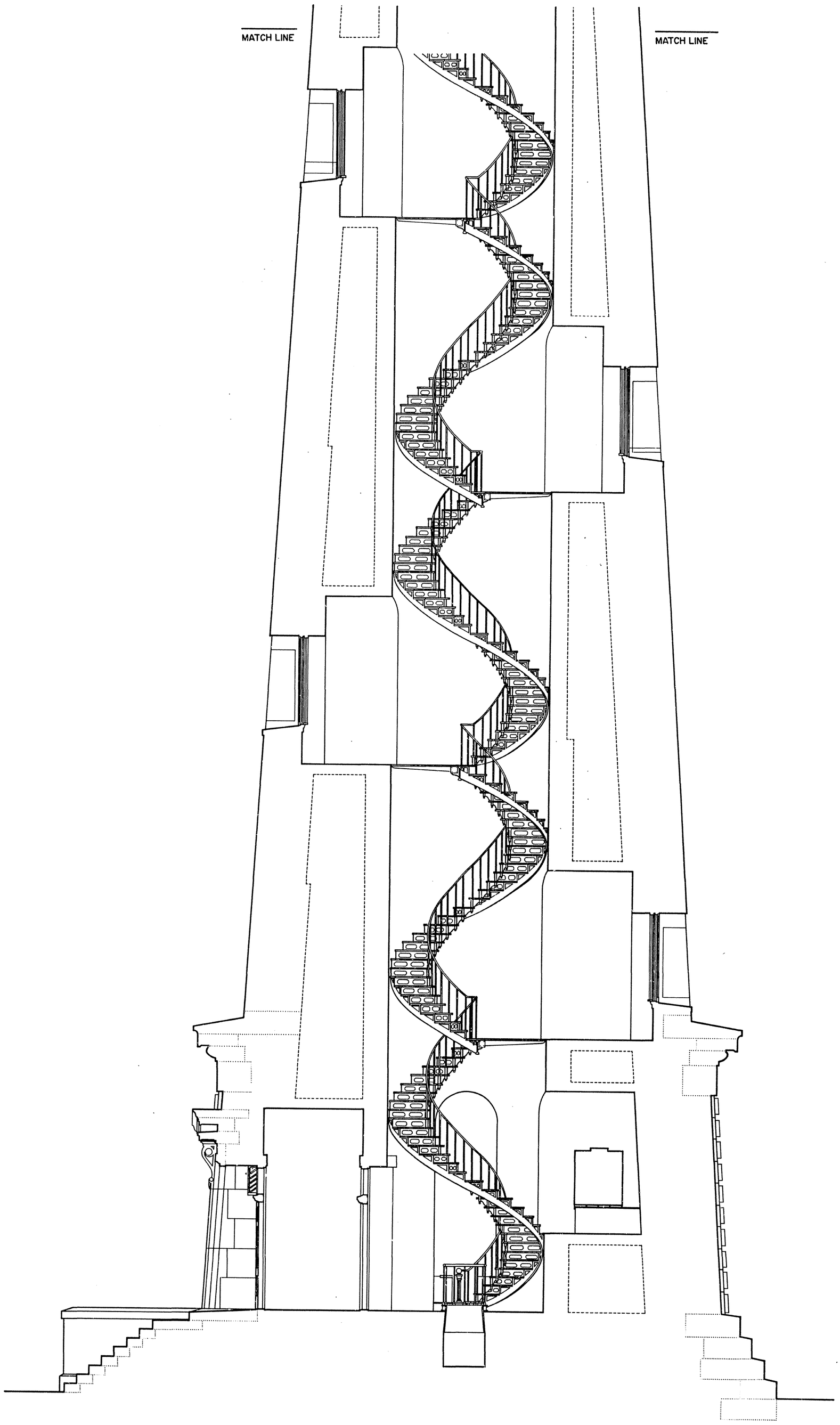
WINDOWS: CAST IRON CASEMENT FRAME
LANTERN: CAST AND WROUGHT IRON WITH PLATE GLASS



SECTION (A-A)
BOTTOM HALF

FEET 1/4" = 1'-0" 0 1 5 10
METERS 1:48 0 1 2 3

DRAWN BY JUDITH E. COLLINS

CAPE HATTERAS NATIONAL SEASHORE
1989
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

BUXTON

NAME AND LOCATION OF STRUCTURE
CAPE HATTERAS LIGHTHOUSE
DARE COUNTY
NORTH CAROLINA

SURVEY NO. NC-357

HISTORIC AMERICAN BUILDINGS SURVEY
SHEET 7 OF 13 SHEETS

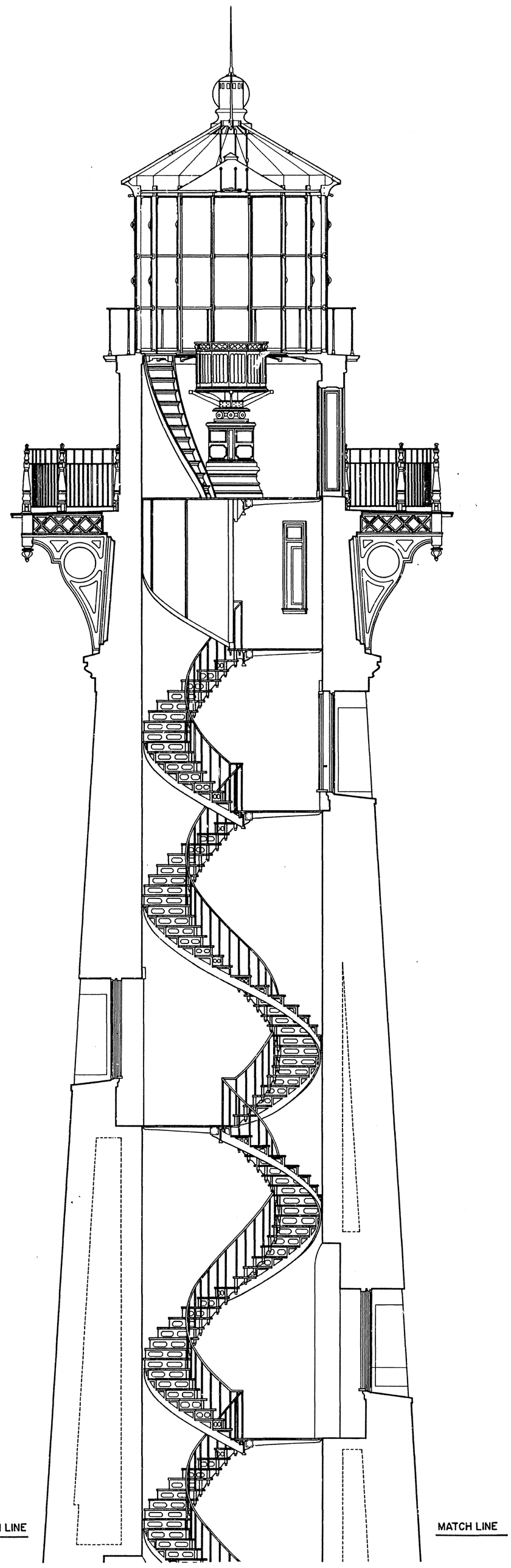
LIBRARY OF CONGRESS INDEX NUMBER

IF REPRODUCED PLEASE CREDIT HISTORIC AMERICAN BUILDINGS SURVEY NATIONAL PARK SERVICE, NAME OF DELINEATOR, DATE OF THE DRAWING

TRIM LINE
TRIM LINE

MATERIALS:

BASE: PAINTED BRICK WITH STONE QUOINING AND FRONTISPIECE
DOOR: METAL
TOWER: PAINTED BRICK WITH INTERNAL CAST AND WROUGHT IRON STAIR
WINDOWS: CAST IRON CASEMENT FRAME
LANTERN: CAST AND WROUGHT IRON WITH PLATE GLASS



SECTION (A-A)
TOP HALF

FEET 1/4" = 1'-0" 0 1 5 10
METERS 1:48 0 1 2 3

DRAWN BY: JUDITH E. COLLINS

CAPE HATTERAS NATIONAL SEASHORE
1989
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

NAME AND LOCATION OF STRUCTURE
CAPE HATTERAS LIGHTHOUSE
BUXTON DARE COUNTY NORTH CAROLINA

SURVEY NO. NC-357

HISTORIC AMERICAN BUILDINGS SURVEY
SHEET 8 OF 13 SHEETS

LIBRARY OF CONGRESS INDEX NUMBER

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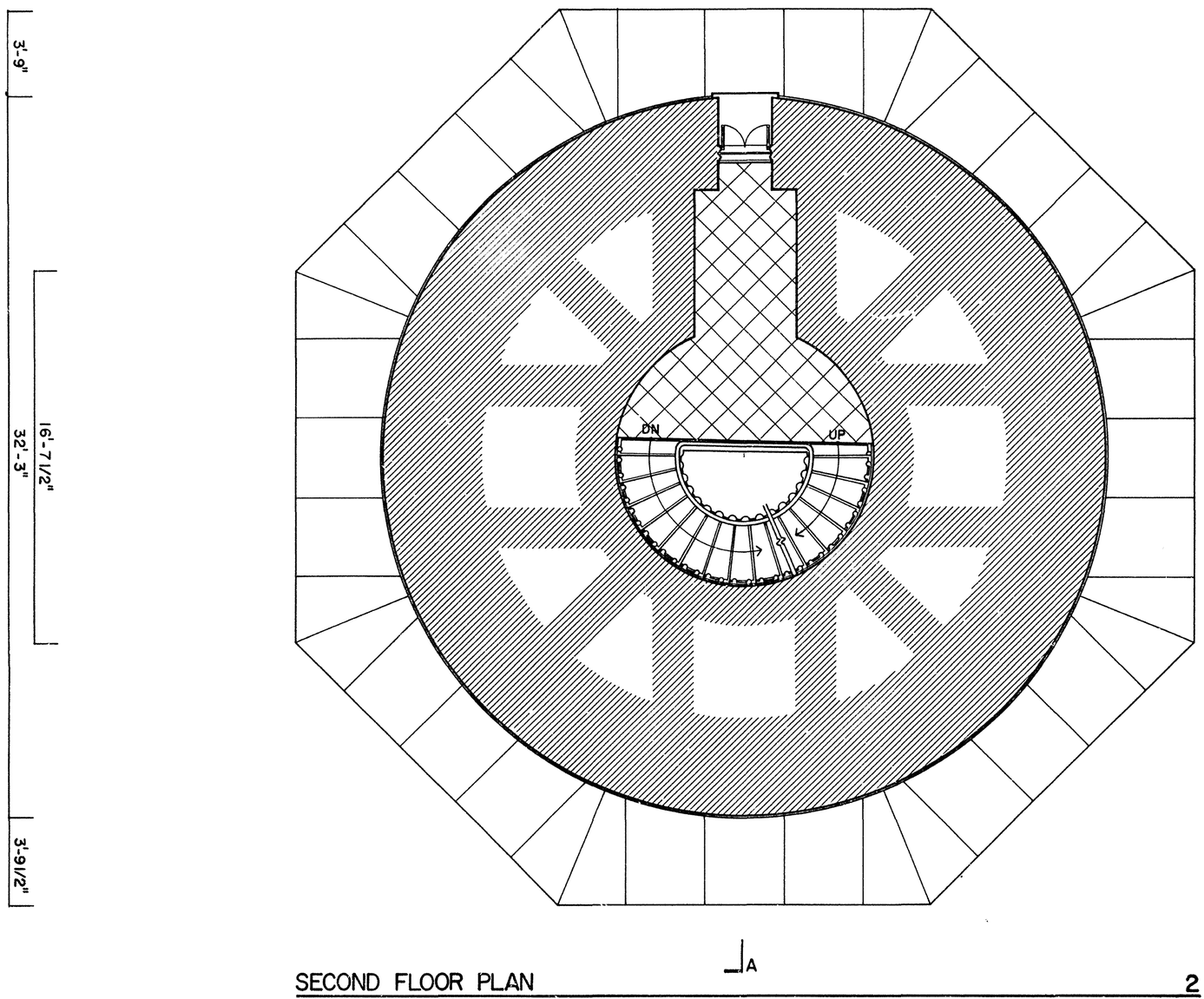
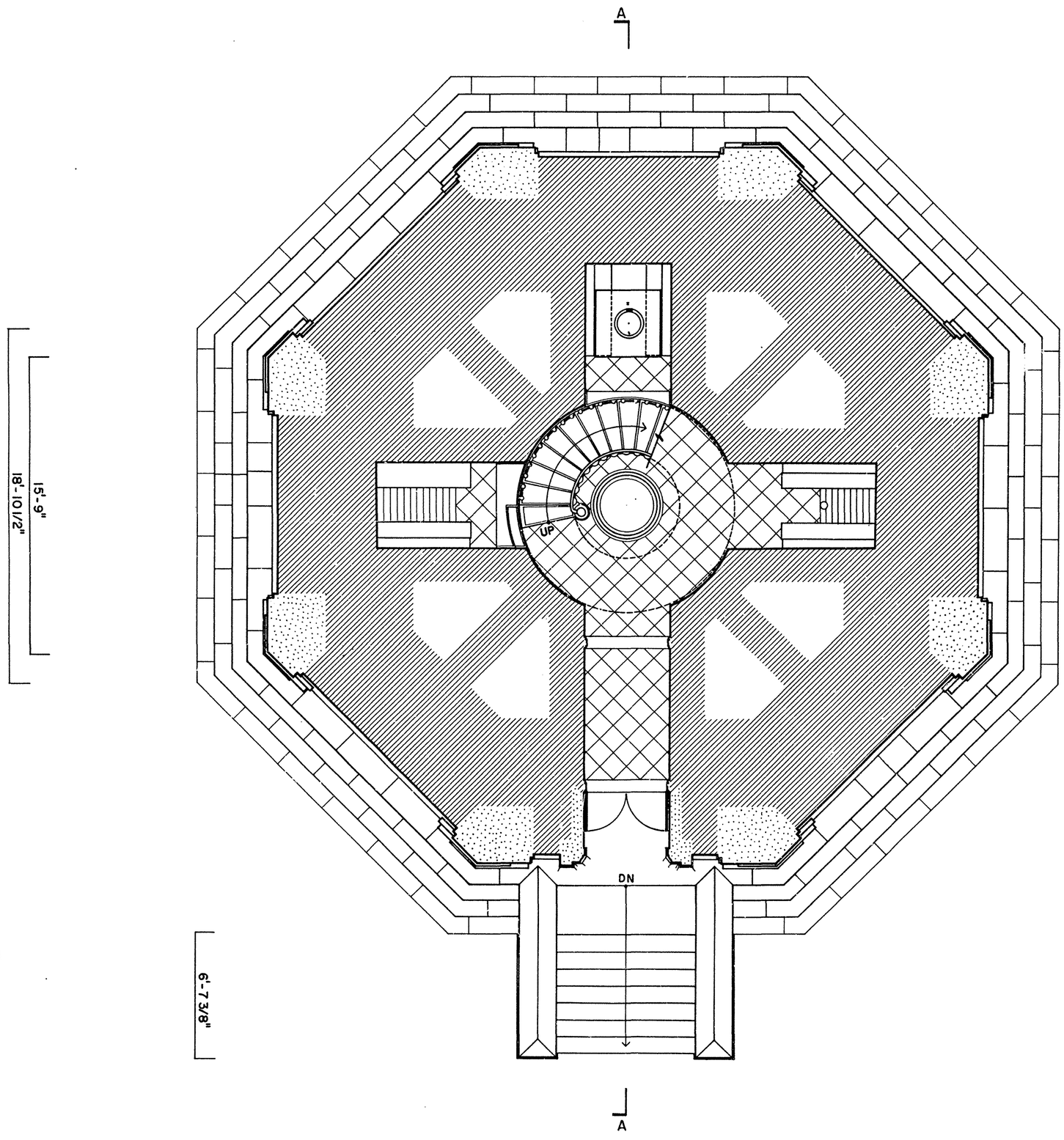
TRIM LINE
TRIM LINE

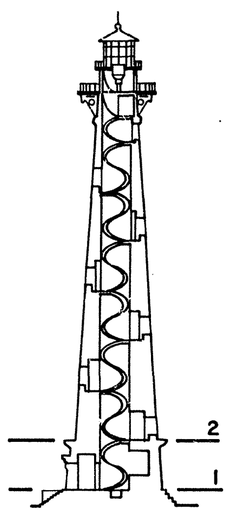
NOTE: THE CONFIGURATIONS OF THE WALL CAVITIES ARE FROM THE FIFTH DISTRICT LIGHT HOUSE SERVICE ENGRAVINGS OF THE CAPE HATTERAS LIGHT HOUSE, 1869, PLATE NO. 2.



SECOND FLOOR PLAN 2



FIRST FLOOR PLAN 1



NORTH

FEET 1/4" = 1'-0" 0 1 5 10
METERS 1:48 0 1 2 3

DRAWN BY: JUDITH E. COLLINS

CAPE HATTERAS NATIONAL SEASHORE 1989 NATIONAL PARK SERVICE UNITED STATES DEPARTMENT OF THE INTERIOR	NAME AND LOCATION OF STRUCTURE CAPE HATTERAS LIGHTHOUSE BUXTON DARE COUNTY NORTH CAROLINA	SURVEY NO. NC-357	HISTORIC AMERICAN BUILDINGS SURVEY SHEET 9 OF 13 SHEETS	LIBRARY OF CONGRESS INDEX NUMBER

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TRIM LINE
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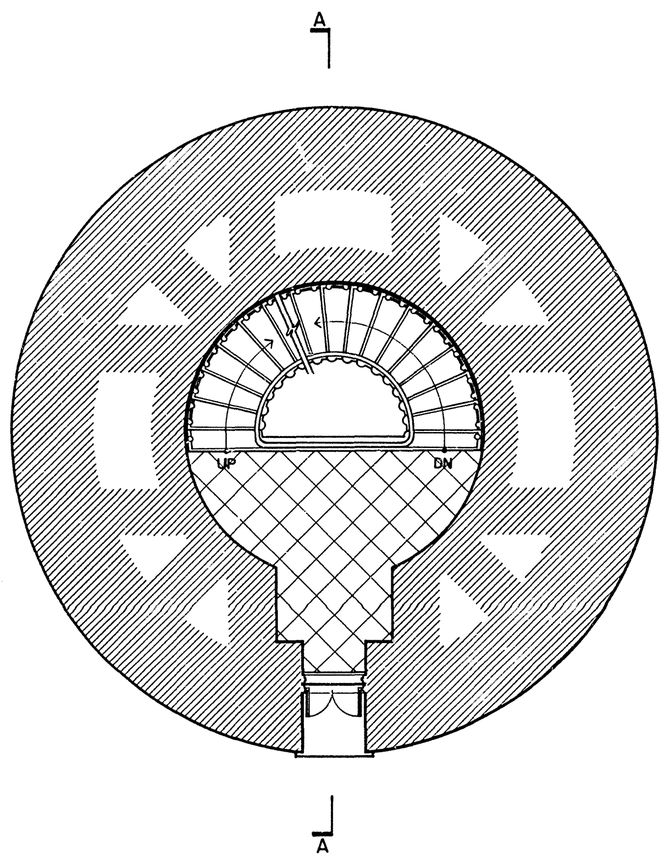
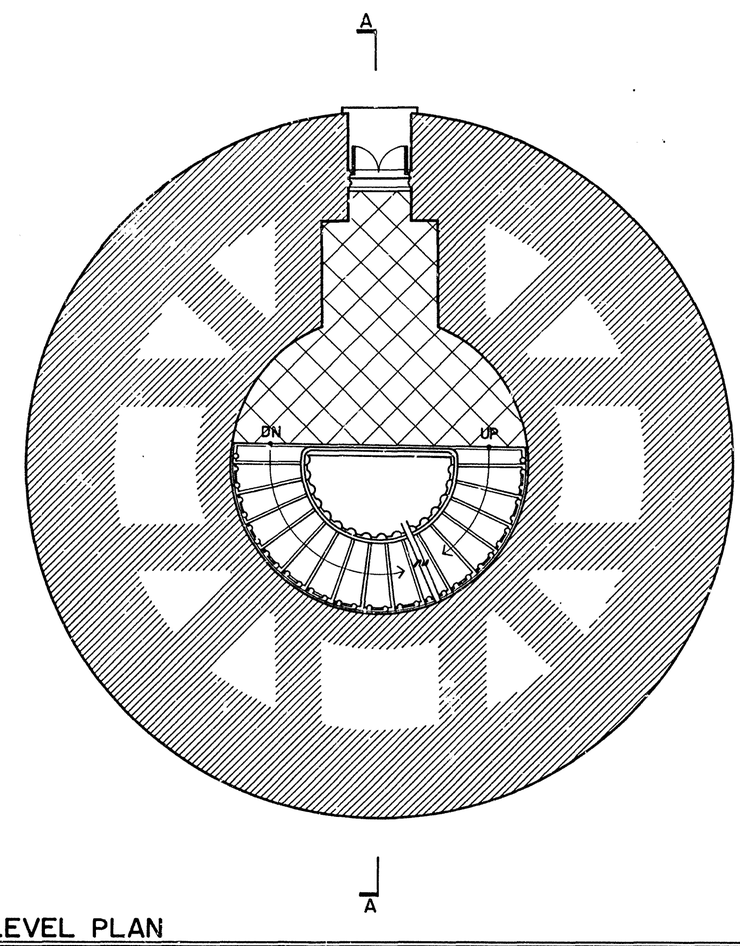
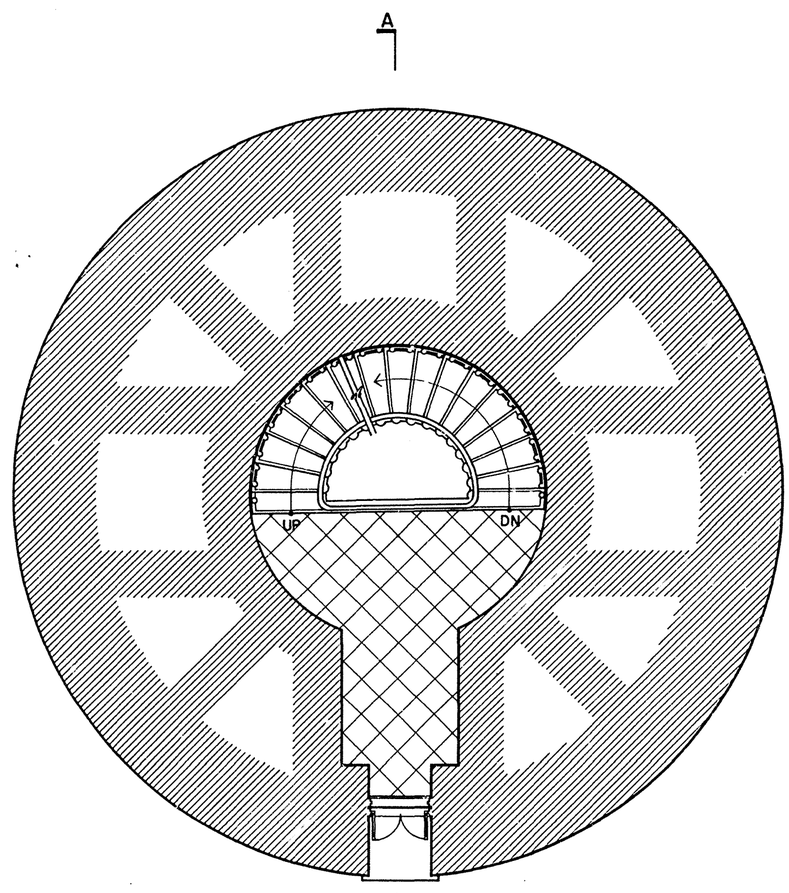
NOTE: THE CONFIGURATIONS OF THE WALL CAVITIES ARE FROM THE FIFTH DISTRICT LIGHT HOUSE SERVICE ENGRAVINGS OF THE CAPE HATTERAS LIGHT HOUSE, 1869, PLATE NO. 2.



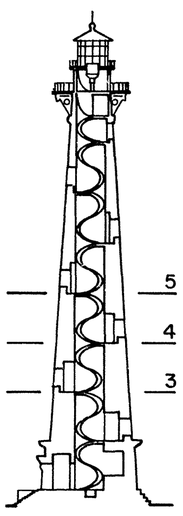
FIFTH LEVEL PLAN 5

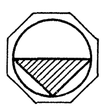


FOURTH LEVEL PLAN 4



THIRD LEVEL PLAN 3





FEET 1/4" = 1'-0" 0 1 5 10
METERS 1:48 0 1 3

DRAWN BY: JUDITH E. COLLINS

CAPE HATTERAS NATIONAL SEASHORE 1989 NATIONAL PARK SERVICE UNITED STATES DEPARTMENT OF THE INTERIOR	NAME AND LOCATION OF STRUCTURE CAPE HATTERAS LIGHTHOUSE BUXTON DARE COUNTY NORTH CAROLINA	SURVEY NO. NC-357	HISTORIC AMERICAN BUILDINGS SURVEY SHEET 10 OF 13 SHEETS	LIBRARY OF CONGRESS INDEX NUMBER

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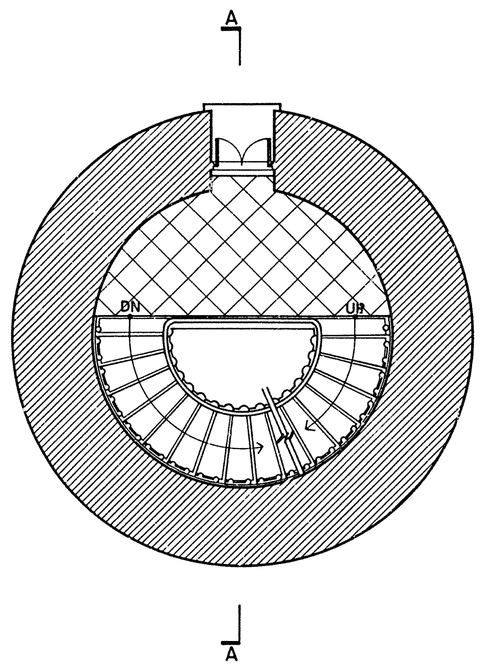
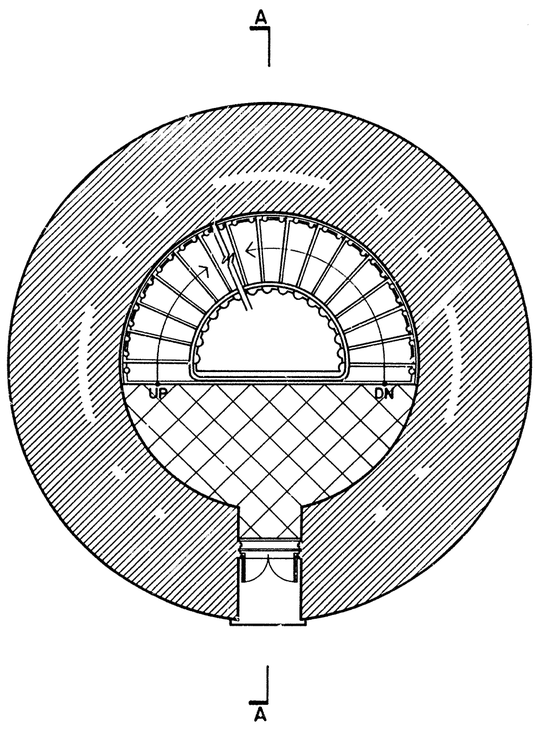
603/25 00X

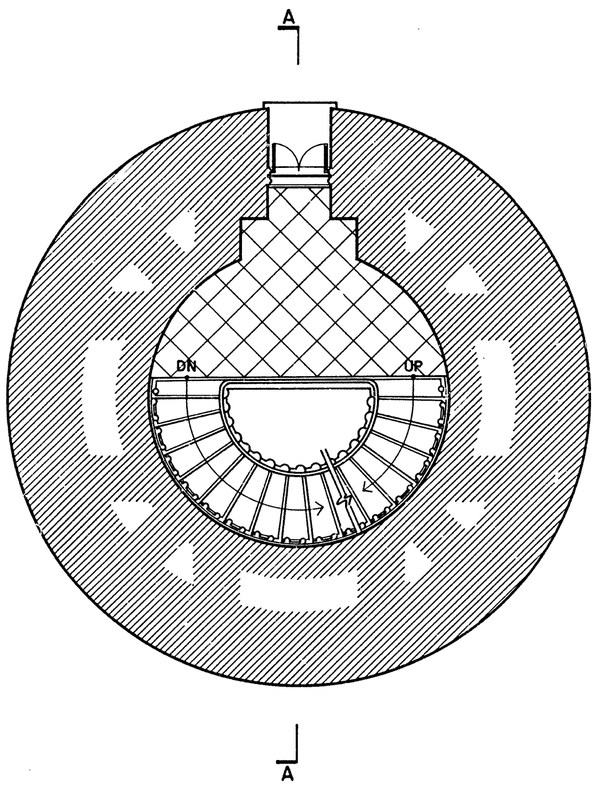
NOTE: THE CONFIGURATIONS OF THE WALL CAVITIES ARE FROM THE FIFTH DISTRICT LIGHT HOUSE SERVICE ENGRAVINGS OF THE CAPE HATTERAS LIGHT HOUSE, 1869, PLATE NO. 2.

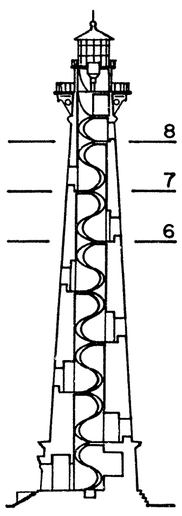


EIGHTH LEVEL PLAN 8

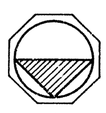


SEVENTH LEVEL PLAN 7





SIXTH LEVEL PLAN 6



FEET 1/4"=1'-0" 0 1 5 10
METERS 1:48 0 1 2 3

DRAWN BY: JUDITH E. COLLINS

CAPE HATTERAS NATIONAL SEASHORE
1989
NATIONAL PARK SERVICE
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SURVEY NO. NC-357

HISTORIC AMERICAN BUILDINGS SURVEY
SHEET 11 OF 13 SHEETS

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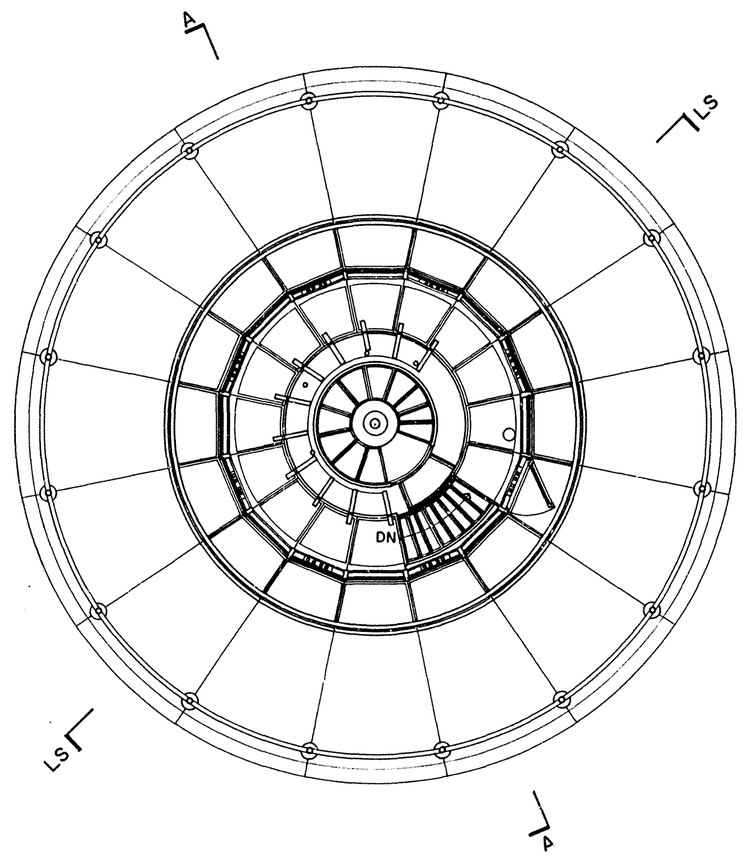
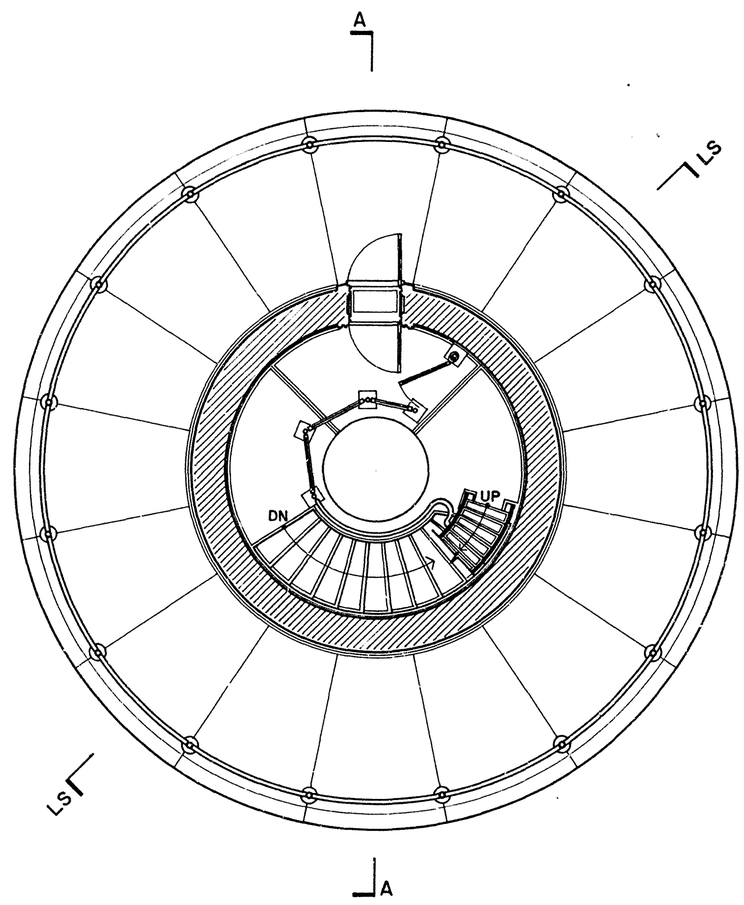
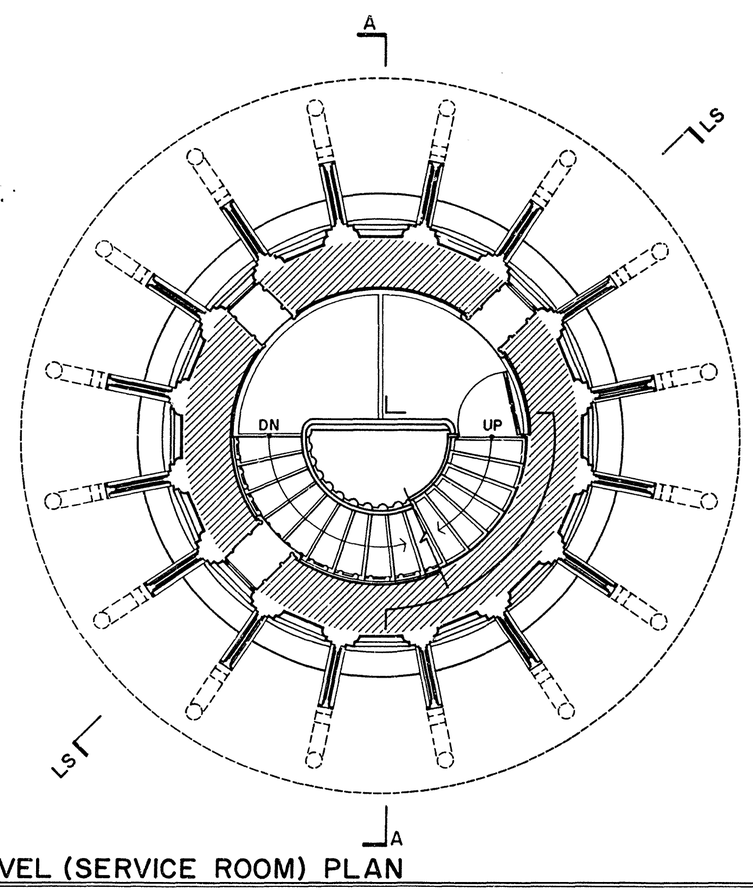


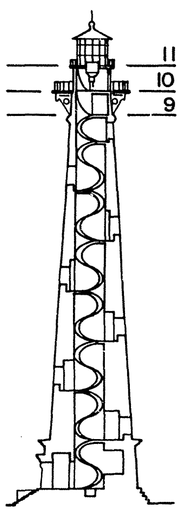
ELEVENTH LEVEL (LANTERN) PLAN 11



TENTH LEVEL (WATCH ROOM) PLAN 10



NINTH LEVEL (SERVICE ROOM) PLAN 9



NORTH

FEET 1/4"=1'-0" 0 1 5 10
METERS 1:48 0 1 2 3

DRAWN BY: JUDITH E. COLLINS

CAPE HATTERAS NATIONAL SEASHORE 1989 NATIONAL PARK SERVICE UNITED STATES DEPARTMENT OF THE INTERIOR	NAME AND LOCATION OF STRUCTURE CAPE HATTERAS LIGHTHOUSE BUXTON DARE COUNTY NORTH CAROLINA	SURVEY NO. NC-357	HISTORIC AMERICAN BUILDINGS SURVEY SHEET 12 OF 13 SHEETS	LIBRARY OF CONGRESS INDEX NUMBER

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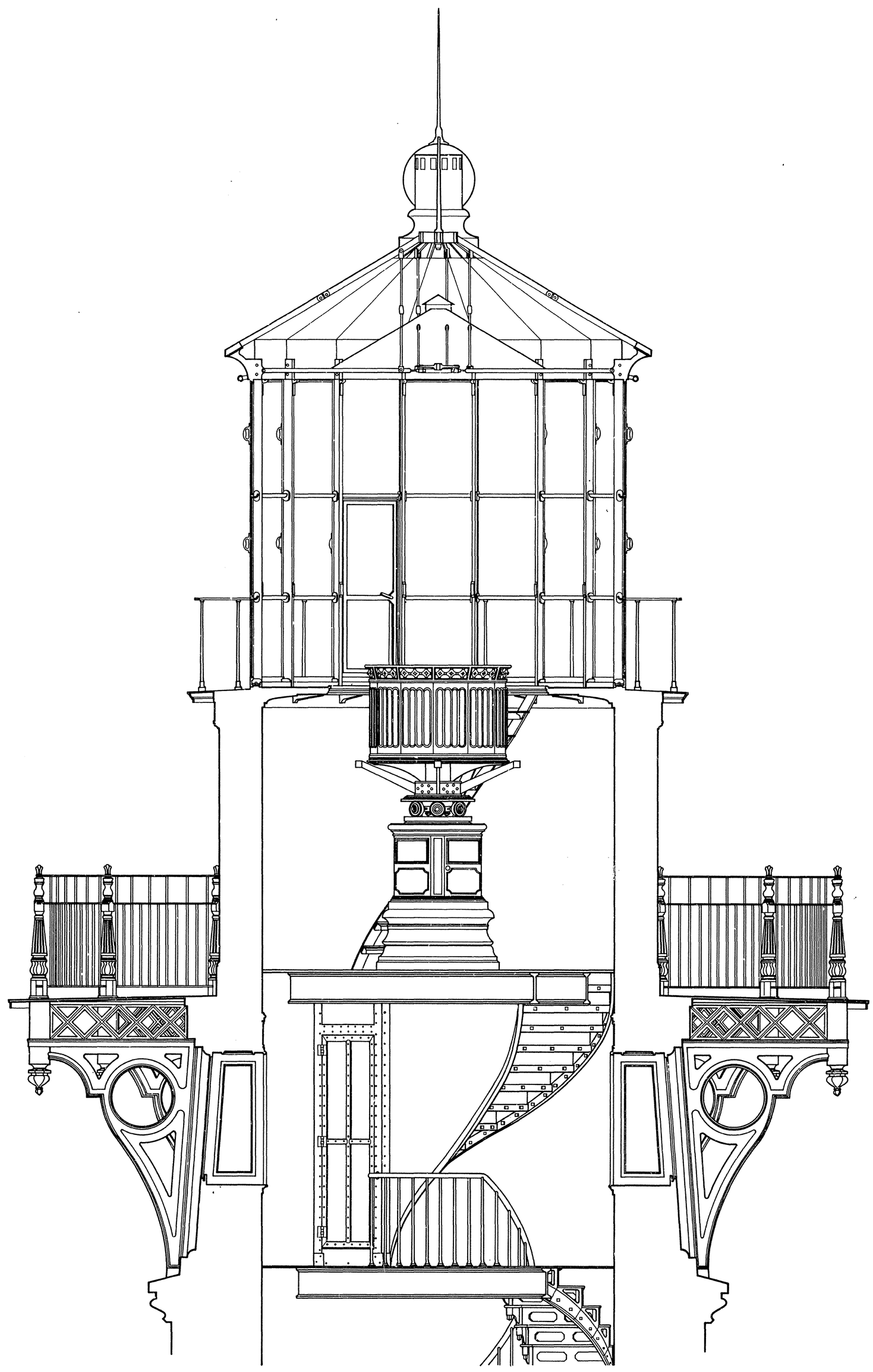

LANTERN SECTION (LS)

FEET 1/2"=1'-0" 0 1 2 3 4 5

CENTIMETERS 1:24 0 50 100 150

DRAWN BY: JUDITH E. COLLINS

CAPE HATTERAS NATIONAL SEASHORE
1989
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

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CAPE HATTERAS LIGHTHOUSE
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SURVEY NO. NC-357

HISTORIC AMERICAN BUILDINGS SURVEY
SHEET 13 OF 13 SHEETS

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TRIM LINE

TRIM LINE

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Appendix I

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Appendix I: 2015 HABS Documentation

In 2015, the Historic American Building Survey (HABS) digitally scanned the lighthouse and surrounding site. The following digital images were produced from the digital scanning:

- East elevation
- North elevation
- South elevation with Keeper's house
- South elevation
- West elevation
- East-West section
- North-South section
- Perspective section
- Perspective view looking northwest
- Perspective view looking southeast
- Perspective view looking west
- Perspective view looking south
- Site perspective
- 3 site plans
- Site section

In addition, a fly-through of the site was created from the data.

All files are provided on the enclosed CD and are not printed for this document to conserve paper.

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