Dry Dock 1

Historic Structure Report

Charlestown Navy Yard • Boston National Historical Park

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HISTORIC STRUCTURE REPORT

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prepared by McGinley Kalsow & Associates

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COVER & TITLE PAGE PHOTOGRAPH:
"Dry Dock 1 Extension Progress, looking North along center line at Caisson sill and hinges, Boston Navy Yard, March 24, 1948."
CNY Archives (BOSTS 8796)

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EXECUTIVE SUMMARY

Research Methodology

Research for this report entailed both field investigations of Dry Dock 1, as well as visits to key archival collections, most notably the Loammi Baldwin Collection at the William L. Clements Library, University of Michigan; the Baldwin Papers at the Baker Library, Harvard University; and the National Park Service's Charlestown Navy Yard Archives. In addition, a number of online collections were consulted. The most useful were the "American Memory: A Century of Lawmaking for a New Nation" at the Library of Congress; and the Boston Public Library's "Electronic Resources: Newspapers," which includes the *Boston Globe* and *New York Times*.

The most significant research finding emerged from the examination of Baldwin's original drawings for the Charlestown and Gosport (Norfolk) dry docks, which confirmed the nearly identical nature of the design of the two dry dock structures. As the most expensive and advanced maritime engineering works in the nation at the time of construction, the two docks contained virtually the same structural elements, from the foundations to the superstructure, along with identical gates, hydraulic systems, and mechanical equipment. Indeed, Baldwin used the same drawings of the Charlestown Dry Dock and the same source of Quincy granite to simultaneously construct the Gosport Dry Dock.

A comparison of the nationally significant Charlestown and Norfolk dry docks today reveals the extent to which the latter dock has remained virtually unaltered from its original appearance, whereas the Charlestown dock has undergone a number of alterations, especially during and after the Second World War as part of a modernization effort to accommodate larger vessels.

From the research work, the major historical events in the development of U.S. Navy dry docks are highlighted in this report, as is Loammi Baldwin's role in the design and construction of the docks. Finally, the key changes to Charlestown's Dry Dock 1 are discussed, with a focus on the dock's character defining features.

Character Defining Features

As noted in this report, Dry Dock 1 contains several defining features, including the original granite chamber and head of dock; the 1856-1860 Inland Extension; the 1901-1905 Steel Caisson and Pumps; the 1941 Head of Dock Modifications; the 1947-1948 Seaward Extension; and the 1960 Dewatering Tunnel Intake. The structural and architectural fabric that constitutes these features is tied to the broader period of historical significance of the dock, namely its years in active service as a U.S. Navy facility.

This period of significance of Dry Dock 1is reflected in the National Park Service's larger statement of significance of the Charlestown Navy Yard, a National Historic Landmark, in which the NPS states that the navy yard stands as one of the nation's foremost sites "in the construction, repair, and servicing of vessels of the United States Navy for the entire period of its existence from 1800 to 1974." Also noted are the important roles of historically important naval officers and secretaries of the U.S. Navy, along with the individuals—most notably Loammi Baldwin, a leading civil engineer in the Early Republic—in the development and growth of the Charlestown Navy Yard and Dry Dock 1 "to meet the changing needs and naval technologies" that emerged over 19th and 20th century.[1]

Recommendations for Treatment and Use

The renovation of Dry Dock 1 for its safe and efficient operation, while carrying out these renovations in a manner sensitive to the historic fabric of this nationally significant structure, will preserve the dock as a "working landmark" for future generations. Recognizing that the dock will be needed in the near future to service USS *Cassin Young*, and that in several years it will be needed to repair USS *Constitution*, this report calls for a phased approach for the dry dock's renovations.

The first phase, to be carried out prior to the docking of USS *Cassin Young* in late 2008, will entail: (1) a comprehensive inspection and rehabilitation of the historic Steel Caisson; (2) the repair of the three electric-powered capstans, including the installation of modern driving mechanisms and the rehabilitation of the historic mechanical elements and housing, which should be compatible with the historic design and materials; (3) the upgrading of water, electric, compressed air and fire suppression utilities in a manner that respects the historic integrity of the dock; (4) the repair of the granite stairs at the head of dock, along with required OSHA-compliant railings for the stairs; (5) the repair of the steel platforms; (6) the repair and upgrading of the keel blocks; (7) the repair or replacement (in kind) of the stanchion-and-chain safety railing around the dock's perimeter; (8) the removal of all vegetation from joints of the granite and concrete work, along with the mucking out of the dock's chamber.

It is recommended that the second or intermediate phase of rehabilitation should be carried out prior to the docking of USS *Constitution* in 2012 and encompass a broad range of renovation work. This includes (1) the repair of all granite altars, step-backs, walls, steps, coping, and flooring; (2) all of the reinforced concrete walls, slabs-on-grade (in the dock chamber and at the coping level), altars, and stairs; (3) the

[1] "Statement of Significance, Charlestown Navy Yard," in Stephen P. Carlson, "Charlestown Navy Yard: Historic Resource Study," v. 1, unpublished manuscript at Boston National Historical Park, 2007, p. iii.

repair and restoration of draft gauges and painted makers; (4) the repair or stabilization of iron rings, cleats, and bollards; and (5) the replacement of the public safety railing with an historically appropriate and ADA-compliant railing.

Finally, a third phase, should be initiated after the completion of dry docking of USS *Constitution* for repairs. This will entail: (1) the removal of the concrete floor at the head of dock and restoration of its granite; (2) the restoration of the center slide and the three bottom steps of the arc at the head of dock; (3) the restoration of the concrete flooring of the propeller pit and the restoration of the granite floor of the original turning gates; and (4) the repair and stabilization of the hand-powered capstans.

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ADMINISTRATIVE DATA

Names, Numbers and Location Data Used to Refer to the Historic Structure

Dry Dock 1 is a granite and reinforced concrete structure measuring overall 415 feet by 100 feet. It is located within the boundary of the National Park Service's Boston National Historical Park and is part of the original Charlestown Navy Yard property.

The LCS Number for Dry Dock 1 is 40078. Within the area of the dock are a number of historic elements. These include: the Steel Caisson (LCS #40087); three electric-powered capstans: Capstan 1 (LCS #40127); Capstan 2 (LCS #40129); and Capstan 3 (LCS #40131); two hand-powered capstans, two inoperable portal cranes; and 98 concrete keel blocks.

Although both the original Engine House (Building 22) and the Pumphouse (Building 123) are historically associated with the operation of Dry Dock 1, these resources are not discussed in detail in this report.

Proposed Treatment of the Structure Including the Source Document

Dry Dock 1 is currently dewatered, but does not contain a vessel. The dock is not currently operable chiefly because the condition of the steel caisson is unknown. (The caisson has been in a closed position since 1996.) Under a cooperative agreement with the U.S. Navy, the National Park Service is required to make Dry Dock 1 available for the repair of USS *Constitution*. Several years ago the staff at Boston National Historical Park developed a series of long-term renovation needs for the dock and these were subsequently input into the computerized NPS Project Management Information System (PMIS). This includes one project that calls for overall rehabilitation of the dock (PMIS #16738); a second project for overhauling the Steel Caisson along with hull repairs to USS *Cassin Young* (PMIS #16306); and a third project for rehabilitating the three electric capstans (PMIS #75135).

To date only one part of the overall rehabilitation of the dock has been carried out and this entailed the repair and restoration of Stairs 1 and 2. This report evaluates all of the projects, as specified in the PMIS, and provides detailed recommendations for the treatment of the historic components associated with the dock. In addition, this report provides a recommended strategy for implementing the required renovation work in a logical phased series of projects.

Related Studies

Mary Jane Brady and Christopher J. Foster, Inc., prepared a "Historic Structure Report: Dry Dock I: Charlestown Navy Yard, Architectural Data," for the Boston National Historical Park in 1979. Although this HSR contains detailed information on the history of the dry dock's construction, most notably on the granite quarrying and masonry work, it does not include a fabric analysis of the many other components associated with the dock, nor does it provide treatment recommendations.[1]

The *General Management Plan*, v. 2, for Boston National Historical Park, produced in 1980, provides an overview of the park's establishment and development. A section on cultural resources management notes that Dry Dock 1 is to be used by the U.S. Navy for the repair of USS *Constitution* and contains a copy of the "Loan Agreement" between the NPS and the Navy, which is the formal basis for this use.

Stephen P. Carlson's "Charlestown Navy Yard: Historic Resource Study," 3 volumes, (unpublished manuscript available at Boston National Historical Park, 2007), includes a section on the history of Dry Dock 1 along with a variety of historic photographs of the dock and its related structures. Separate entries on the electric-powered capstans and the Steel Caisson were especially valuable resources. Carlson also consulted a number of congressional reports related to naval affairs and these documented Baldwin's planning for the dry docks at Charlestown and Norfolk.

In addition to the work of Carlson, the published Historic Resource Studies by Edwin C. Bearss and Frederick Black contain some historical information on Dry Dock 1, though most of it relates to the development and alterations to the dock, *vis-à-vis* congressional appropriations for planning and carrying out construction work.

Cultural Resource Data

A National Register survey conducted by Edwin C. Bearss in 1978 includes a short entry on Dry Dock 1. Short summaries on the dry docks at Charlestown and Norfolk were prepared about the same time by the American Society of Civil Engineers as part the society's publication of its National Civil Engineering Landmarks. Both the NR survey and the ASCE landmark statement highlight the technological significance of the Charlestown dock, as well as the role of nationally renowned civil engineer Loammi Baldwin in its design and construction.

[1] This HSR was prepared along with Christopher J. Foster, Inc., "Investigation and Evaluation of the Water Seepage Occurring in Drydock No. 1," March 1979. This study focused on the problems of seepage through the concrete walls and through sections of the older granite walls. A number of the Foster's recommendations for patching concrete and regrouting the joints of the granite masonry are still valid and are addressed in this HSR.

Recommendations for Documentation, cataloging and Storage of Materials Generated by the HSR

Original documents and correspondence related to Baldwin's design of the Charlestown and Norfolk dry docks are housed in collections of Baldwin papers and the University of Michigan and Harvard University. For this HSR, drawings that were the most informative and graphically legible were selected and reproduced in electronic (digital) format. In addition, Robert Stewart developed a set of drawings from these original works, detailing specific features of the Charlestown dock and changes to the dock over time. At Boston National Historical Park, an archive containing U.S. Navy drawings, including at least one from the hand of Alexander Parris and dating from 1840, is well organized and the documents are well catalogued.

Although no HABS/HAER documentation project has been carried out at Dry Dock 1, the combination of historic materials collected for this HSR and the archival materials at Boston National Historical Park, would make such a project especially rewarding. The nearly original designs of the Charlestown and Gosport docks, along with the dramatically different appearances of these two docks today, suggests that the most fruitful approach for a HABS/HAER project would be to document the two national landmarks together.

Research Team

Paul McGinley of McGinley Kalsow & Associates LLP led the research team along with industrial historians Gray Fitzsimons and Robert Stewart. Wendall Kalsow, historical architect, provided technical input for the repair and restoration of historic materials. From the National Park Service, Stephen Carlson, Preservation Specialist, provided detailed history and information about Dry Dock 1 and its relationship to the adjacent areas of the yard, while Bill Barlow, Historical Architect, contributed to the evaluation of the dock's integrity. Phil Hunt, Museum Specialist, provided access to archival plans and photographs that documented key details of the dock's evolution.

Further Research Recommended

The research of this HSR along with previous research efforts have documented all of the character defining features of Dry Dock 1 except for the original plans and specifications of the 1901 Steel Caisson that was the first steel hull fabricated in the Charlestown Navy Yard and is still in operation. The rehabilitation of the caisson is a high priority recommendation before the upcoming dry-docking of USS *Cassin Young* in 2008. The location of these plans and specifications would be most valuable in the inspection, evaluation and development of sensitive proposals to renovate and rehabilitate the Steel Caisson. This research should be undertaken immediately.

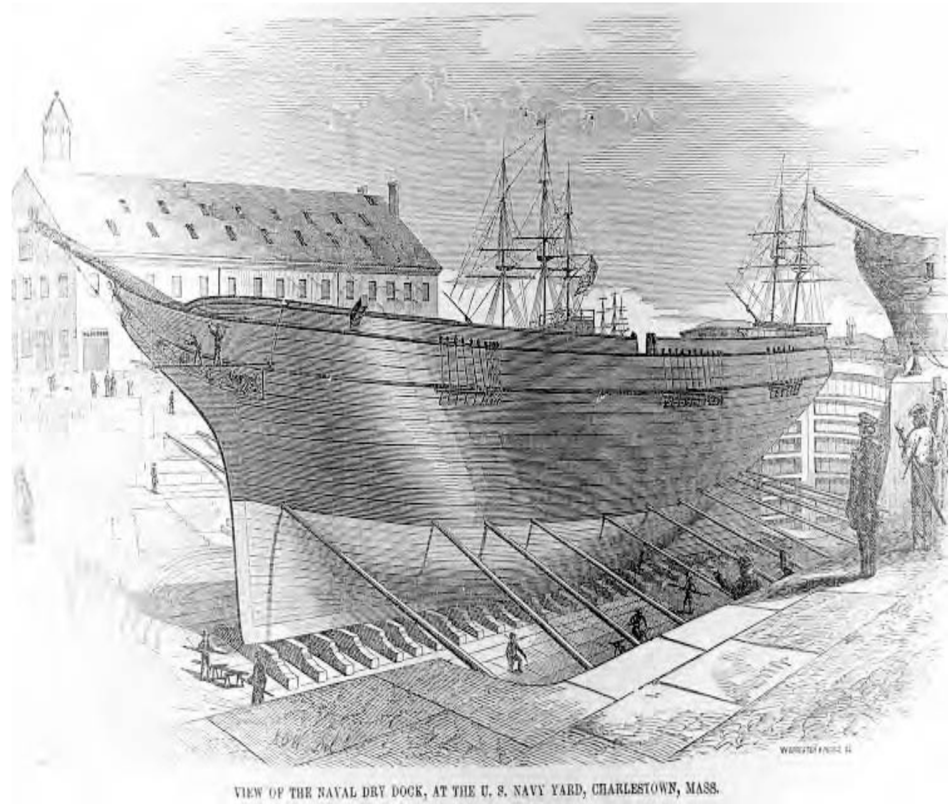
PART 2 | DEVELOPMENTAL HISTORY

A. Historical Background and Context

Introduction

From the age of sail and wooden ships, to the period of steam and iron vessels, and finally to the era of steel ships, the Charlestown Navy Yard has played a significant role in the nation's military and industrial history. Established in 1800 under the aegis of Benjamin Stoddert, the first United States Secretary of the Navy, the yard was one of six federal shipyards that began operations during the early years of the 19th century. Naval officers and personnel, along with shipyard workers, engaged in a wide range of activities at Charlestown in support of the growing United States Navy. This included the supply, construction, and repair of numerous naval vessels.

In the 1820s a number of prominent naval men, including Secretary of the Navy Samuel L. Southard, believed that the establishment of dry docks was essential to the operation of the nation's fleet. Located within a navigable stretch of the shore, a dry dock—essentially an enclosable basin in which vessels may be berthed, the water drained from the basin, and repairs or construction undertaken while the vessel rests on blocks—was among the most sophisticated of maritime structures. Their design and construction required a high degree of civil and mechanical engineering skills.[2] At the time, only France and England possessed the most modern dry docks, a fact



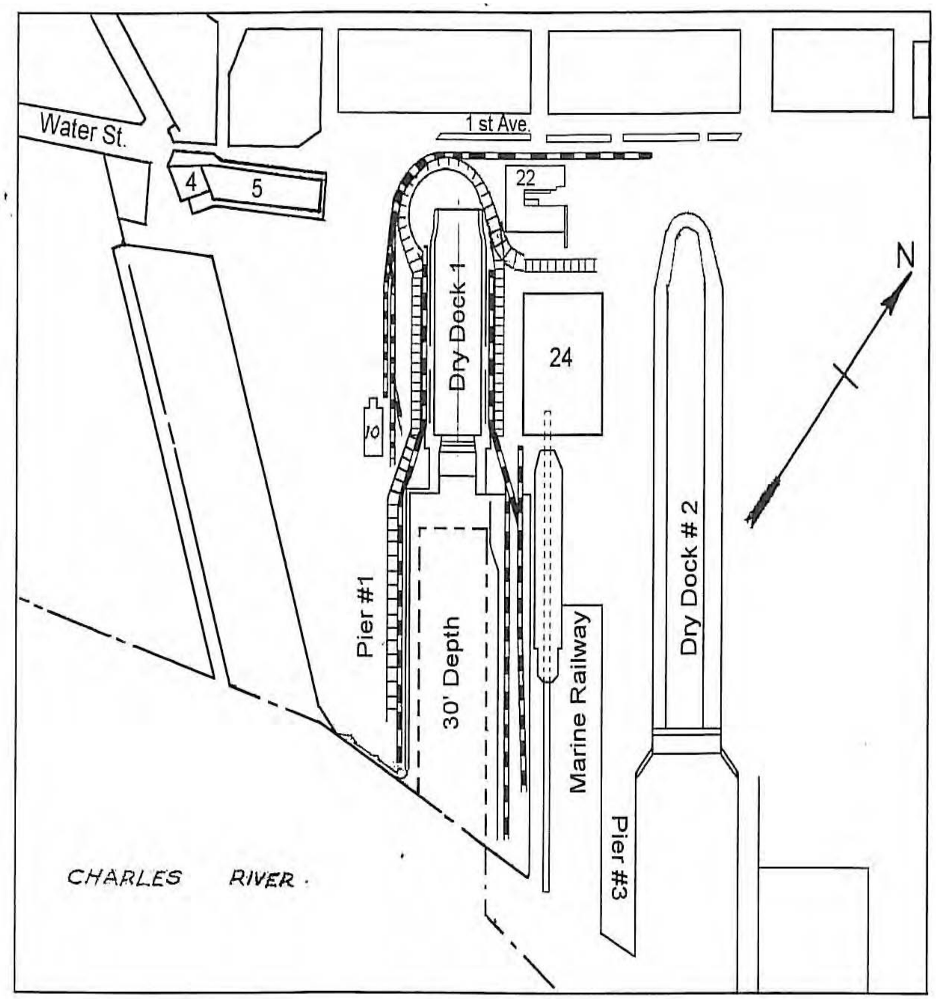
(B1)* View of Dry Dock 1 in 1851.

*Note on numbering of historic images: Each historic image appears in Appendix B where these images are organized chronologically for greater ease in analyzing changes to Dry Dock 1 over time. Hence, the numbers that appear in the narrative of the report are not in sequential order, but conform to the numbering of the images as they appear in Appendix B.

[2] Dry docks, built by excavating into the ground, are also referred to as "graving docks." The best historical source on dry docks in North America is Charles Beebe Stuart, *The Naval Dry Docks of the United States*, (New York: Charles B. Norton, 1855). Stuart wrote this book shortly after serving as chief engineer for the construction of the U.S. Navy's dry dock at its New York yard.

recognized by Massachusetts-born Loammi Baldwin, the engineer to whom Southard turned to design and supervise the construction of America's first large-scale dry docks.[3] It was Baldwin and Southard who would prove instrumental in recommending that Charlestown be selected as one of two sites for massive granite-masonry dry docks. When completed in 1833, Charlestown's Dry Dock 1, as it became known, was considered an engineering marvel and boosted Boston's reputation as a center of naval activity in the United States.[4]

By the late 1860s the Charlestown Navy Yard had doubled in size and contained naval quarters, workshops, warehouses, a foundry, and forge, as well as its renowned Dry Dock 1 and the nationally acclaimed Ropewalk. Such craft-oriented trades as woodworking, metalworking, caulking, painting, and rope-making dominated the yard, which annually employed between 800 to 1,000 workers. Further expansion occurred in the 20th century, during the years surrounding the two world wars, most notably between 1933-1945 when the yard became more of a shipbuilding facility and less a repair yard. It was also at this time that the facility, formally named the Boston Naval



Location Plan for Dry Dock 1.

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[3] The world's first dry dock was built in the late-15th century in Portsmouth, England. In 1669, the French constructed the first stone dry dock at Rochefort. Soon after, the English built a masonry dock for its Royal Navy, centered at Portsmouth. Richard D. Hepburn, P.E., *History of American Naval Dry Docks: A Key Ingredient to a Maritime Power*, (Arlington, VA: Noesis, Inc., 2003), p. 1.

[4] Hepburn, *History of American Naval Dry Docks*, pp. 13-15 & 23. For this HSR, Hepburn's book helped significantly to establish a context for Charlestown's Dry Dock 1 in relation to other naval dry docks.

Shipyard, adopted modern fabrication technologies and mass production processes, eclipsing the older craft-based methods and trade union organizations.[5]

During the 1950s the U.S. Navy increasingly relied on private corporations to build and repair its fleet. This change dealt a serious blow to the value of the nation's navy yards and they became increasingly vulnerable to budget cuts. In the 1960s Secretary of Defense Robert S. McNamara sought to consolidate operations in the nation's navy yards and ordered closing of facilities in Boston, New York and Philadelphia. Political opposition, however, blunted this action. Only the New York yard was shut down. The official end of U.S. Navy operations at Charlestown occurred in 1974. That same year, however, President Gerald Ford signed an act creating the Boston National Historical Park, a unit of the National Park System that encompassed historic sites in Boston and Charlestown. Among these sites was the "Charlestown Navy Yard," which comprised approximately 30 acres of property within the southwest area of the yard.[6] This included many of its historic buildings, shipyard structures, and its most storied vessel USS *Constitution*.[7] In addition, in 1978 the National Park Service acquired from the Navy the World War II destroyer USS *Cassin Young* to operate it as a museum for park visitors. As part of its loan agreement, the National Park Service was required to make Dry Dock 1 available to the U.S. Navy for periodic maintenance and repairs to USS *Constitution*. Thus, among the yard's many historic structures, Dry Dock 1 continues to function, albeit with some modifications, as it was originally intended.

In 1966, the National Park Service recognized the Charlestown Navy Yard as a National Historic Landmark (NHL). A brief statement prepared in support of the yard's NHL designation proclaimed that the "Boston Naval Shipyard is one of the nation's oldest [navy yards], and for over 150 years has built, repaired, and serviced naval vessels." Furthermore, it declared that the shipyard "introduced shelters for shipways, erected one of the nations' first stone dry docks, and pioneered in modern ship construction."[8] Almost a dozen years after the NHL designation of the Navy Yard, the American Society of Civil Engineers (ASCE) accorded Dry Dock 1 national civil engineering landmark status, observing that it "is one of the earliest major structures of its type in the U.S., and probably the Western Hemisphere." At the same time, the ASCE similarly recognized the Baldwin-designed dry dock at the Gosport (Norfolk) Navy Yard, built at the same time as Dry

[5] The most detailed histories of the Charlestown Navy Yard are: Edwin C. Bearss, *Historic Resource Study: Charlestown Navy Yard, 1800-1842*, 2 volumes, (Washington, DC; National Park Service, 1984), Frederick R. Black and Edwin C. Bearss. *The Charlestown Navy Yard, 1842-1890*, (Boston: Boston National Historical Park, 1993); and Frederick R. Black, *Charlestown Navy Yard, 1890-1973*, 2 volumes, (Boston: National Park Service, 1988).

[6] Over the years the yard has undergone a number of name changes. In the 19th century, and up until 1945, the designation of "Charlestown" and "Boston" were used interchangeably. As part of a reorganization of naval shore operations in 1945, the yard was formally named the Boston Naval Shipyard. With the Boston National Historical Park designation in 1974, the yard was officially renamed the Charlestown Navy Yard.

[7] Goody, Clancy & Associates, "Building 24 Historic Structures Report, Charlestown Navy Yard, Boston National Historical Report," September, 2003, p. 8.

[8] United States Department of the Interior, National Park Service, "National Survey of Historic Sites and Buildings: Boston Naval Shipyard, Massachusetts," October 18, 1966, Boston NHP Archives, BOSTS-13347, Box 25.

Dock 1. (The Gosport dock was subsequently accorded NHL status by the National Park Service). In addition, the ASCE nomination pointed out that Loammi Baldwin and his associates successfully completed the dock despite "the dearth of scientific knowledge of hydraulics and geotechnology" at the time of its design and construction.[9]

In conjunction with the NPS historic site surveys, as well as the NHL and ASCE designations, this Historic Structure Report recognizes the significance of Dry Dock 1 in relation to the development and history of naval operations at the Charlestown Navy Yard, from the period of its original design and construction, through its active use by the U.S. Navy.[10] The "Periods of Significance," highlighted below, are derived from the NHL statement and the subsequent National Register Survey. Moreover, they correspond to the original design and construction of Dry Dock 1, as well as to major alterations to the original dock.[11] One final point should be noted: The National Park Service, in agreement with the U.S. Navy, continues to maintain and operate Dry Dock 1, specifically in connection to repair work performed on USS *Constitution*. As a result, Dry Dock 1 functions today much as it did at its inception in the early-19th century. Thus it remains unique compared to many other historic structures whose active lives, as originally conceived, have come to an end.

The Origins of Charlestown's Dry Dock

During its first dozen years of operation the Charlestown Navy Yard was scarcely more than a supply depot. The yard encompassed the Commandant's House (1805) and the Marine Barracks (1811), as well as carpenter and blacksmith shops, storage sheds, and a saltwater dock. Most of the repair work and outfitting was done in nearby privately owned yards and docks. In the wake of the War of 1812, however, Congress provided funds for the yard's first significant expansion. Led by Captain William Bainbridge (1774-1833), Charlestown's second commandant, the Navy erected a large stone wharf and building slip. It was in this slip that Bainbridge oversaw the

[9] In 1977, the ASCE also designated the Gosport Dry Dock a national civil engineering landmark. Both nominations are summarized in American Society of Civil Engineers, *ASCE Guide to History and Heritage Programs*, (New York: ASCE, 1988), p. 31.

[10] This emphasis on the years encompassing U.S. Naval operations at the Navy Yard, as constituting its nationally significant history, is in accordance with the views of NPS Historian Edwin Bearss, who conducted a comprehensive National Register Survey of the Charlestown Navy Yard around 1978. Bearss' findings underscored the fact that the navy yard's history and buildings are tied to the Industrial Revolution and to technological advances in the United States, which emerged in the late 19th and early 20th century as the leading industrial and naval power in the world. He concluded that the Charlestown yard "retained more of its architectural components—and hence its continuity—than any other major naval facility, and it therefore documents the full scope [of its history]." As for Dry Dock 1, Bearss highlighted it as "a structure of exceptional significance in the history of American technology and to the navy because of its early date and continued use at the navy yard." See National Register of Historic Places, "National Register Survey, Charlestown Navy Yard," May 1978.

[11] The historical narrative that follows is drawn from a variety of primary and secondary sources. Of the latter category, one of the most useful was Mary Jane Brady and Christopher J. Foster, Inc., "Historic Structure Report Dry Dock 1, Charlestown Navy Yard, Architectural Data" unpublished report prepared for the Denver Service Center, National Park Service, U.S. Department of the Interior, 1979. It is important to note that, while this earlier HSR was consulted and is appropriately cited, the authors of this present volume have used a number of primary and secondary sources that were not included in this earlier work.

construction of USS *Independence*, the nation's first 74-gun ship-of-the-line vessel, launched in 1815.

Although two additional 74-gun ships were begun at Charlestown between 1818 and 1822 the U.S. Navy was reorienting its fleet toward lighter, more maneuverable warships. Prominent in this transformation was New Jersey-born Samuel Lewis Southard (1787-1842), appointed as Secretary of the Navy in 1823 by President James Monroe. Southard embarked on an ambitious program to upgrade the nation's naval operations and shipyards, purchasing land for the first naval hospitals and ordering the construction of new shops and dry docks. Southard, who remained Secretary of the Navy through the administration of President John Quincy Adams, played an important role in the improvements to the Charlestown Navy Yard, including the development of its massive stone-constructed Dry Dock 1, as well as an identical dry dock in Virginia at the Gosport (later Norfolk) Navy Yard.[12]

The most noteworthy individual associated with the design and construction of the dry docks at Charlestown and Norfolk, was Loammi Baldwin (1780-1838), the son of Loammi Baldwin, Sr., engineer of the famous Middlesex Canal. Born in Woburn, Massachusetts, and educated at Westford Academy, the younger Baldwin assisted his father on the survey and construction of the Middlesex Canal. Upon his graduation from Harvard in 1800 he studied law and then established a law practice in Cambridge. Baldwin, however, retained a keen interest in mechanics and engineering, developing a series of proposals for public works projects in support of the Federalist program of merchant-oriented commerce and international trade.

One of Baldwin's proposals, published in 1804, promoted the expansion of the U.S. Navy to boost the nation's maritime interests. "Prosperity for a commercial people," Baldwin wrote, "depends upon a good navy. England and France found a navy necessary for greatness, and the United States must find likewise."[13] Key to the growth of the navy was the improvement of America's naval facilities. Moreover, Baldwin specifically called for the incorporation of dry docks

[12] Southard also undertook surveys of U.S. coastal waters and promoted exploration of the Pacific Ocean. Administratively, he clashed with a number of powerful naval officers but in so doing Southard reinforced the American tradition of civilian control over its military. For more on Southard see Michael Birkner, *Samuel L. Southard: Jeffersonian Whig*, (Rutherford, NJ: Farleigh Dickinson University Press, 1984).

[13] Baldwin's writings, titled "Dry Docks." were published in a series of articles in the Boston-based periodical *Columbian Centinel*, between January 25, 1804 and May 26, 1804. Parts of these articles appear in Frederick K. Abbott, "The Role of the Civil Engineer in Internal Improvements: The Contributions of the Two Laommi Baldwins, Father and Son, 1776-1838," (unpublished Ph.D. dissertation, Columbia University, 1973). For these quotes see Abbott, p. 63.

Portrait of Loammi Baldwin, from the ASCE's *Biographical Dictionary of American Civil Engineers*. In 1824, the 43-year-old Baldwin was described as being slightly taller than 6'-1", with grey hair, grey eyes, and a sallow complexion.[14]

into the U.S. Navy's yards.[15] "Many European nations," he contended, "have within a few years greatly improved in ship building…This important improvement, especially in the mechanical part of the work, has been chiefly owing to their widely adopting the dry docks." Baldwin concluded that "America, possessing all which nature could give, ought to follow the same tract and rival European nations in marine architecture."[16] He recommended that a dry dock be built at once in Charlestown.[17]

Baldwin quit the legal profession and beginning in 1807 served as an engineer on fortification, harbor, road, and canal projects in Virginia, Pennsylvania, and Massachusetts.[18] In 1824, nearly 20 years after Baldwin had proposed his ambitious plan for building U.S. Navy dry docks, a majority of congressmen embraced this idea.[19] Congress authorized Secretary of the

[14] "Certificate of Departure," April 29, 1824, Loammi Baldwin Collection, William L. Clements Library, University of Michigan.

[15] Prior to the establishment of dry docks, repairs to the hulls of ships were performed by a process called "careening," whereby a vessel was docked or guided to a mud flat and then heaved over at low tide. Workmen then carried out repairs while the vessel rested on its side. This unwieldy and time-consuming process was also potentially damaging to the ship as careening resulted in severe structural stresses to the hull.

[16] "Dry Docks: No. I," *Columbian Centinel*, January 25, 1804.

[17] Abbott, p. 63.

[18] For a summary of the many engineering projects in which Loammi Baldwin served as chief engineer see his entry in *A Biographical Dictionary of American Civil Engineers*, (New York: American Society of Civil Engineers, 1972), pp. 6-7.

[19] On at least one occasion, prior to the 1820s, Congress supported the construction of dry docks. An act passed in 1813 authorized an appropriation of $100,000 for the "purposes of establishing a dock yard," but the war with Britain overwhelmed the U.S. Navy's capacity to carry out the work. In 1815, the Board of Naval Commissioners urged the building of dry docks, including one at Charlestown. However, Congress did not act upon this recommendation. For a summary of congressional and naval activities on dry dock construction prior to 1824 see U.S. Congress, "Dry Docks," *Naval Affairs*, v. 2, 18th Congress, 2nd Session, January 5, 1825, pp. 1032-1035.

Navy Southard to conduct a study for dry dock construction. Southard promptly turned to Baldwin to prepare plans and designs. Baldwin's work was guided by the Board of Naval Commissioners, which had been established in 1815 to oversee the construction projects and operation of the nation's navy yards and facilities. William Bainbridge, who was reappointed commandant of the Charlestown yard in 1823, served as one of the commissioners.[20] He and Baldwin forged a close relationship and, during the engineer's various survey efforts in the 1820s, Bainbridge and Southard drew upon Baldwin's expertise in his effort to build several dry docks, including one at the Washington Navy Yard.[21]

Much of Baldwin's initial work for the U.S. Navy, however, focused on the construction of a dry dock at the Charlestown Navy Yard. In early January 1825, he presented a plan to build a masonry dock there, estimating its cost at $280,000.[22] The following year, assisted by his half-brother, George Rumford Baldwin, Baldwin carried out additional surveys for constructing dry docks at navy yards in Portsmouth, New Hampshire; Brooklyn, New York; and Norfolk, Virginia. He also refined his plan for the Charlestown dock. Baldwin completed his report in late 1826 and Secretary Southard presented it to Congress in January 1827.[23]

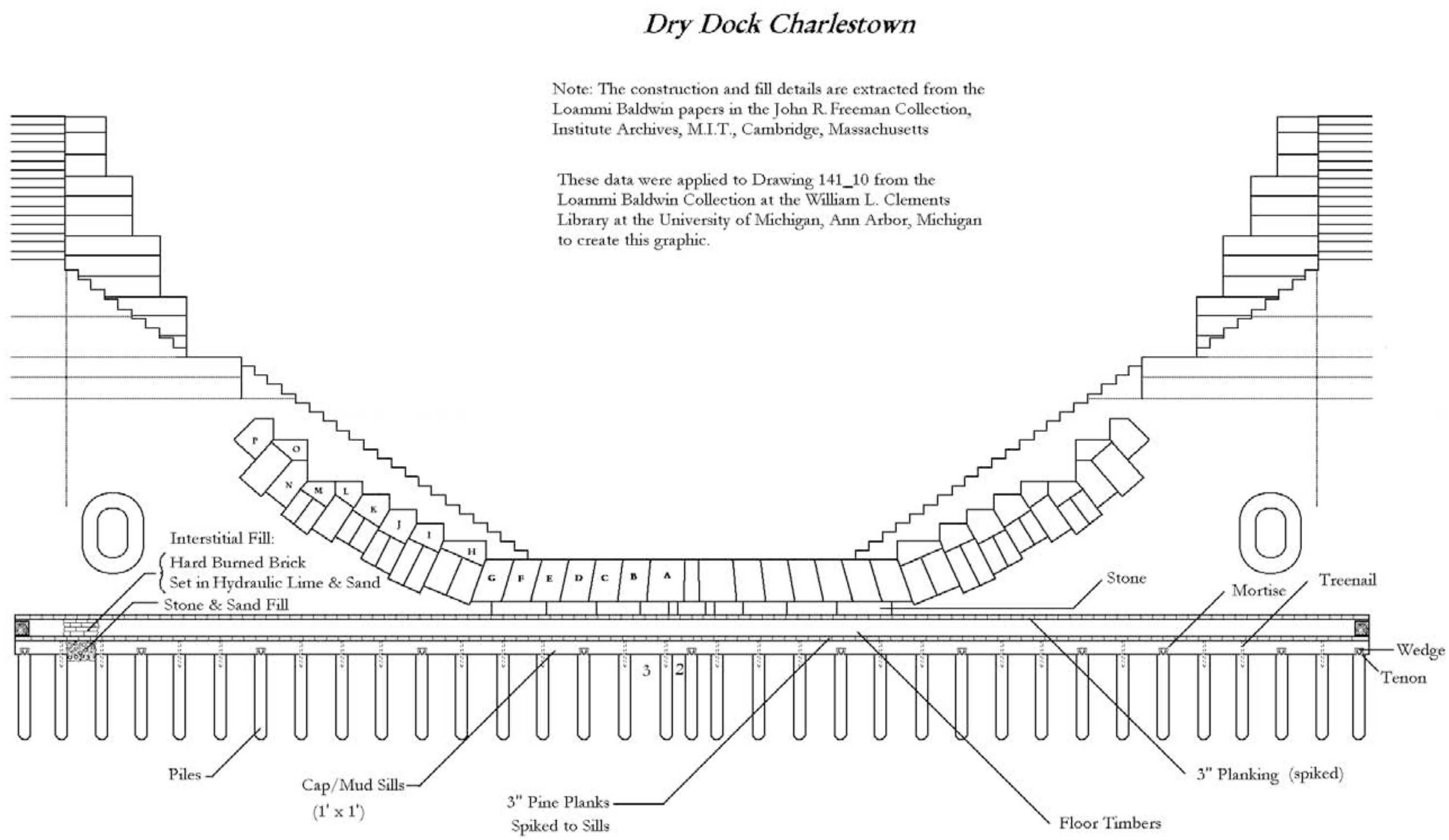
Baldwin's design, which called for substantial masonry dry docks, the first of their kind to be built in America, received the enthusiastic endorsement of Secretary Southard. In March 1827, Congress authorized the construction of docks at Charlestown and at Norfolk. The cost of the Charlestown dock

[20] Bainbridge served as commandant at Charlestown several times, the last two being in 1823-24 and 1832-33. See Bearss, v. 1. pp. 401-04; v. 2, pp. 625-26. The Board of Naval Commissioners was created February 7, 1815, as part of an expansion of the U.S. Navy Department, but its authority was generally confined to procuring stores and materials and to constructing, arming, and equipping vessels of war. The Secretary of the Navy remained in control of many operational aspects of the Navy. The Board was abolished on August 31, 1842, and Congress established the bureau system in the Department of the Navy, a system which lasted until the mid-1960s.

[21] In March 1825, Southard directed the Board of Commissioners to have Baldwin examine the practicality of constructing a dry dock in place of an existing inclined plane that was then being used for building frigates. See the letter from William Bainbridge to Loammi Baldwin, March 5, 1825, in "The Loammi Baldwin Collection," William L. Clements Library, University of Michigan. In addition to the dry dock projects, Baldwin undertook another large survey for the U.S. Navy, this one entailing plans for a marine railway at the Navy Yard in Pensacola, Florida. Baldwin completed this work in 1829, during the construction of the dry docks in Charlestown and Norfolk. See U.S. Congress, "On the Erection of a Radiating Marine Railway for the Repair of Sloops-of-War, at the Navy Yard at Pensacola," *Naval Affairs*, v. 3, 21st Congress, 1st Session, May 13, 1830, pp. 577-81.

[22] In a letter, dated March 30, 1826, to Secretary of the Navy Southard, Bainbridge stated, "It may be estimated, from the report of Mr. Baldwin, that a dock of sufficient size for a ship of the line would cost about $300,000." See U.S. Congress, "On the Construction of Docks for the Preservation and Repair of United States Vessels," *Naval Affairs*, v. 2, 19th Congress, 1st Session, March 31, 1826, p. 704.

[23] A copy of Baldwin's report, dated December 28, 1826, was published in U.S. Congress, "Examination of Sites for the Establishment of a Dry Dock for the Navy," *Naval Affairs*, v. 2, 19th Congress, 2nd Session, January 10, 1827, pp. 811-29. In this report, Baldwin increased the cost estimate of the dry dock at Charlestown to nearly $357,000.



(C21) Cross section of Dry Dock 1, adapted by Robert Stewart from original drawings in the Loammi Baldwin Collection, William L. Clements Library, University of Michigan.

amounted to $677,089, substantially more than Baldwin's initial estimate.[24] Southard placed Baldwin in charge of both projects. Initially, Baldwin sought to appoint his half-brother George and brother James Franklin Baldwin to serve as his assistant engineers. Neither was available, however, and he selected Alexander Parris (1780-1852), a prominent Boston architect and engineer, to help oversee the work at Charlestown.[25]

Construction of the Dry Dock, 1827-1833

Baldwin contracted for construction work in the summer of 1827. Among the major awards was one for the massive blocks of granite provided by Gridley Bryant, agent for the Granite Railway Company that operated a rail line from its quarry in Quincy, Massachusetts, to its shipping wharfs in nearby Neponset. Arguably, Bryant could be credited for building the first railroad in America in 1826. It was used for moving granite from the Quincy quarries to Massachusetts Bay for transport by a coastal vessel, known as a "lighter," to the site of the Bunker Hill Monument. A well known construction engineer who had invented a portable derrick for hoisting such building materials as stone and heavy timbers, Bryant, along with his partner Solomon Willard, opened the Quincy Quarry in 1826. Their operation brought together improved techniques in stone cutting, the use of rail transport via gravity and draft animal power, and adoption of improved hoisting equipment to load vessels with stone for shipping over water.[26] As a result, a growing number of builders, architects, and engineers, such as Loammi Baldwin, specified granite masonry in their designs. At Charlestown, Dry Dock 1 and the nearby Bunker Hill Monument were early examples of this new building technology and emerging architectural style.[27]

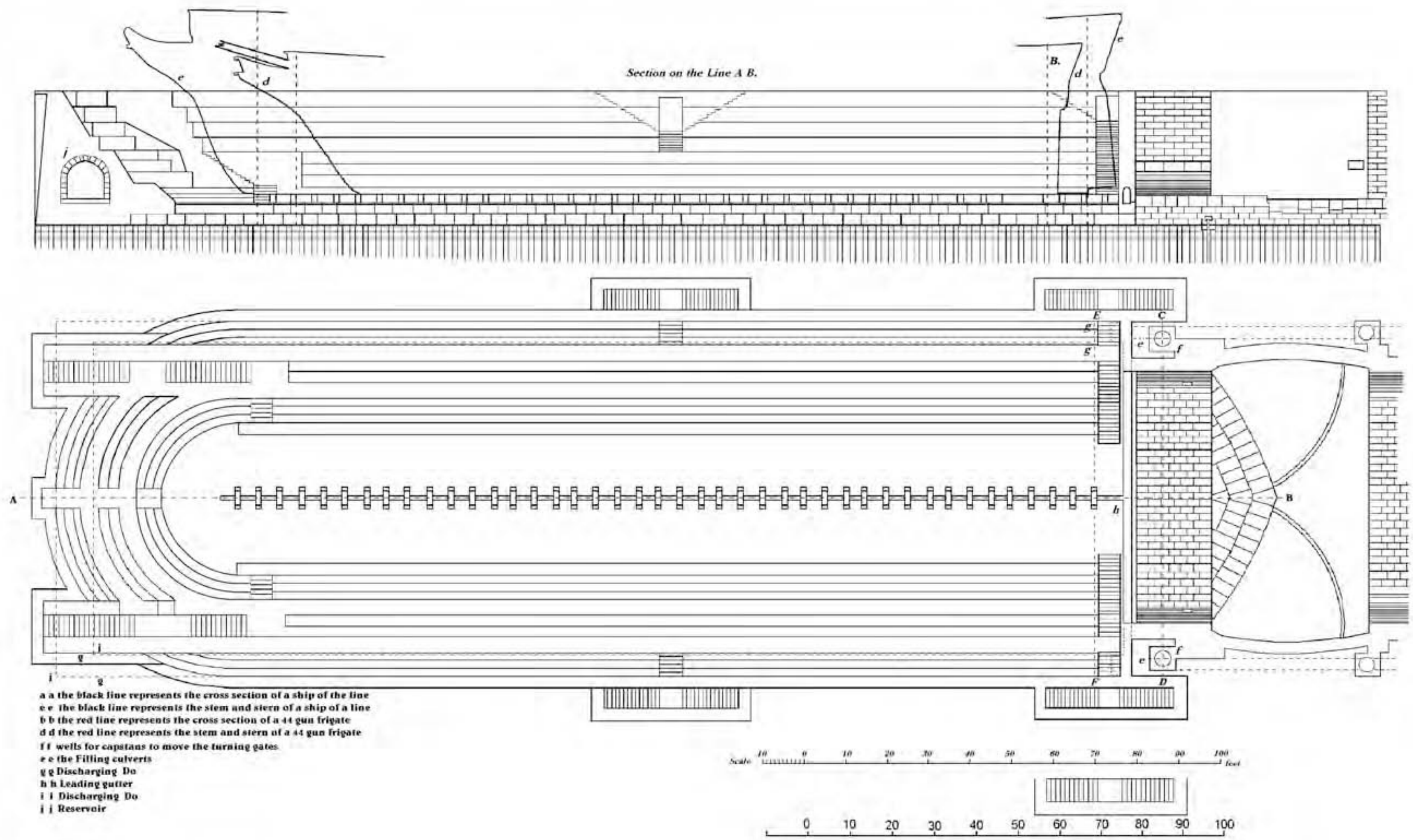
An observer in 1831 commented on the outstanding quality of the Quincy granite and in the workmanship of constructing the dry dock. "The whole masonry," this writer declared, "is estimated to contain forty thousand tons. The whole stone work is of grey granite, from the Quincy quarries, worked with

[24] The dry docks at Charlestown and Norfolk were the most expensive federally funded projects up to that time.

[25] During his years as assistant to Baldwin, Parris designed the Engine House in which the great steam engine and pumps were installed. After completion of Dry Dock 1, Parris worked for the Board of Naval Commissioners, designing the famous Ropewalk, completed in 1837. Parris is best known as architect of Quincy Market (1824-26) in Boston. For more on Parris' contributions during his years at the Charlestown Navy Yard see Helen W. Davis, Edward M. Hatch, and David G. Wright, "Alexander Parris: Innovator in Naval Facility Architecture," *IA: The Journal of the Society for Industrial Archeology*, v. 2, no. 1, (1976): pp. 3-22.

[26] Brady and Foster, pp. 52-61. For more on stone cutting methods used in Quincy quarries in the early 19th century, along with a concise summary of the Quincy Granite Railroad's construction and operation, see Mary Gage and James Gage, *The Art of Splitting Stone: Early Rock Quarrying Methods in Pre-Industrial New England, 1630-1825*, 2nd edition, (Amesbury, MA: Powwow River Books, 2005), pp. 36-40 & 66-67.

[27] Between 1825 and 1845, the extensive use of granite masonry, especially in a number of Boston's finest buildings by such architects as Solomon Willard, Alexander Parris, and Isaiah Rogers, fostered an architecture referred to as the "Boston Granite Style." For more on this architectural development, as well as James Gridley Bryant's role in the growth of granite stone as a building material, see John Morrill Bryan, "Boston's Granite Architecture, c. 1810-1860," (Unpublished Ph.D. dissertation, Boston University, 1972).



(C20) Plan and section of Dry Dock 1, adapted by Robert Stewart from original drawings in the Loammi Baldwin Collection, William L. Clements Library, University of Michigan.

as much neatness and elegance as if the several stones were prepared for the front of a dwelling house."[28] Of all the expenditures for materials in the construction of the dry dock, the masonry amounted to almost $117,000, or nearly one third the total cost of materials.[29]

Along with the granite stone, Baldwin recognized that another critical aspect of his design was the selection of cement for use in the mortar of the masonry work. Baldwin experimented with a number of hydraulic cements before deciding on a mortar that he found satisfactory. His report for 1829 detailed the mixing procedure.

> We have found that an excellent composition for the mass of masonry is obtained, by mixing common lime after being slacked, with the cement. A cask of lime with a cask of cement, & a due proportion of sand, makes a mortar that soon hardens, & in such works, it may be found highly serviceable & much cheaper than cement alone. When very hard and firm water cement is required, for face work &c. we use cement and sand altogether the mixture being half sand, and half cement[30]

Baldwin contracted Peter Remsen & Company, a New York firm, to produce the specified lime and hydraulic cement mixture.[31]

In addition to contracting for materials, Baldwin awarded several other contracts for construction work. For excavation and earthwork he hired Irish-born contractor Hugh Cummiskey who, in 1821-22, built sections of the power canals associated with the massive cotton mills in Lowell, Massachusetts. Another local contractor, William P. Riddle, supplied timber, plank, and piles for the heavy foundation and wharf.[32]

Another important part of the dry dock contract was the design and fabrication of a steam engine to power the pumps that would drain the basin. In fact, apart from the foundation, flooring, and walls, the hydraulic-mechanical design of Dry Dock 1 was the most complicated element of this engineering work. The system of drains, culverts, and the floating gate, along with the steam engine and pumps, were critical to the successful operation of the dry dock. Ebenezer A. Lester, an early Boston-based steam engine designer, was initially engaged by Baldwin to design the "Great Steam Engine for

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[28] "Dry Dock," *The New England Magazine*, vol. 1, no. 4, (October 1831), p. 347.

[29] The total expenditure of materials for the dry dock at Charlestown was about $332,000. See U.S. Congress, "Abstract of Expenditures on the Different Branches of the Dry Dock in Boston for the Year Ending October 3, 1833," *Naval Affairs*, v. 4, 23rd Congress, 2nd Session, , p. 370. This report also indicates that labor for the masonry work, amounting to $123,500, was the single largest labor cost for the entire project. Total labor costs for the dry dock amounted to $345,170.

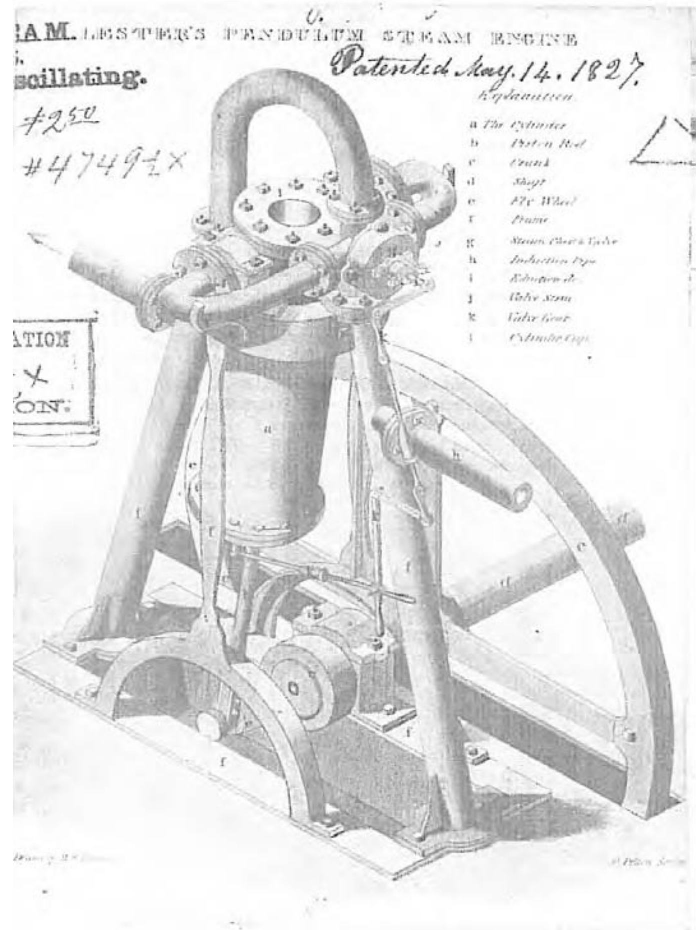
[30] Loammi Baldwin to the Board of Naval Commissioners, "Annual Report for the Year 1829," Baldwin Collection, vol. 73, Baker Library, Harvard University.

[31] Baldwin apparently carried out these experiments in 1829 and selected Remsen's product that year. See Brady and Foster, pp. 11-12.

[32] Brady and Foster, pp. 9-10.

draining the Dock."[33] Lazell, Perkins & Co., of Bridgewater, Massachusetts, manufactured the engine, while William Lyman supplied the pumps. The pendulum engine had a 16-inch cylinder and a four-foot stroke and would be operated with six boilers fired by anthracite coal.[34]

Construction began in the summer of 1827, with work commencing on the pier and wharves at the dry dock site.[35] At about the same time workers began building a cofferdam near the proposed seaward end of the dock. Completed in May 1828, the cofferdam prevented the tide from flooding the construction site and excavation for the dock was then initiated.[36] Over the next year, much of the work was centered on building the dock's foundation. This included driving more



Patent Drawing of Ebenezer Lester's pendulum steam engine.

[33] One of the nation's important early steam engine designers, Lester patented his pendulum steam engine in early 1827. According to one historian, the pendulum engine was no better or worse than the more common oscillating engine and saw little use other than at a few sites in the Boston area. See Carroll W. Pursell, Jr., "Ebenezer A. Lester's Pendulum Steam Engine," *Technology and Culture*, v. 10 (January, 1969), pp. 65-67.

[34] Abbott, p. 181.

[35] Much of the material for this summary of the construction history of Dry Dock 1 is drawn from Stephen P. Carlson, "Charlestown Navy Yard: Historic Resource Study," 3 volumes, (unpublished manuscript available at Boston National Historical Park, 2007). See especially Volume 2, containing the "Resource Inventory" for Dry Dock 1, pp. 152-54. This manuscript is hereinafter referred to as "HRS."

[36] Seepage of groundwater into the excavated site was handled by a small, temporary oscillating steam engine designed and built by Ebenezer Lester in 1828. This engine successfully dewatered the dock during its construction. Loammi Baldwin to J. Willard Phillips, Dry Dock Office, Charlestown, June 23, 1830, The Loammi Baldwin Collection, William L. Clements Library, University of Michigan, Ann Arbor. In addition to Carlson, "HRS," see Brady and Foster, pp. 7-15, for more on the construction history of Dry Dock 1.

than 4,000 timber piles, which was completed in the fall of 1829. The distinctive granite stone work was begun during the construction season of 1830 and by November of that year workers finished nearly three-quarters of the masonry structure. By November 1831 all of the masonry work was completed and the building of the Engine House was well underway.

On June 13, 1832, the great engine and pumps were tested for the first time and operated successfully.[37] Later that year, contractors finished most of the masonry and paving work, along with the turning gates, and floating gate (or caisson). Overall, the dry dock measured 340 feet by 100 feet. The remaining work, which included the removal of the cofferdam, the dredging of the channel, and completion of the wharves, was concluded in the spring of 1833. Although it took nearly six years to complete the dock—Southard had optimistically anticipated the dry dock would be constructed in two years—the work was accomplished with few serious problems. Only a breach in a section of the cofferdam, which occurred in 1832, delayed the project by about six weeks.[38]

[37]Baldwin, Loammi. Annual Reports to the Secretary of the Navy, 1827-1833 Harvard Graduate School of Business Administration, Baker Library, Historical Collections.

[38] For a summary report on the construction of the Charlestown dry dock see U.S. Congress, “Annual Report of the Secretary of the Navy, Showing the Condition of the Navy in 1832, *Naval Affairs*, v. 4, 22nd Congress, 2nd Session, November 4, 1832, p. 164. In this same report the Secretary of the Navy noted the far greater problems encountered by workers at the Gosport site, including an outbreak of cholera in the summer of 1832 that brought the project to a virtual standstill. Despite these difficulties the Gosport dock was completed at about the same time as Dry Dock 1 at Charlestown.

Image of the Gosport Dry Dock at the celebration of its commencement of operations in June 1834.

With work largely completed, on June 24, 1833, the frigate USS *Constitution* entered Dry Dock 1, one week after the first docking at Gosport. Later that year the nation’s first stone-constructed dry docks—in Charlestown and Gosport—were turned over to the U.S. Navy with much acclaim. Baldwin would continue his work with the Navy, planning and conducting survey work for a third masonry dry dock at the New York Navy Yard. Measuring 349 feet in length, it was the largest masonry dry dock in the world.[39] The esteemed engineer did not live to see the completion of this massive dock in 1851.

[39] Hepburn, pp. 25-34.

Early Years of Operations

Upon commencing operations at Dry Dock 1 the Navy performed periodic maintenance work to keep the dock in functioning condition. In the early 1840s, for example, sections of the masonry were repointed and workers repaired drainage pipes, extended brick culverts to deeper water, dredged the entrance to the dock, and installed new keel blocks. Another project involved the installation of an iron post-and-chain barrier around the perimeter of the dock. This was carried out at the behest of the commandant in response to a severe injury to a naval officer who fell into the dock.[40]

During the late 1840s and early 1850s use of the dry dock increased for the repair of vessels, though most of these were not part of the U.S. Navy's fleet.[41] The rising usage of the dock prompted the Navy to carry out more substantial work between 1853 and 1855, when the original caisson (floating gate) and turning gates were heavily repaired, and a new steam engine replaced the Lester-designed engine.[42] Upon the installation of this new, more powerful steam engine, a visitor to the dry dock observed, "These pumps are so capacious that twelve hogshead of water are said to be thrown off at one stroke; and the time occupied in pumping out the dock is about six hours."[43]

The Inland Extension, 1856-1860

The most significant work, however, occurred between 1856 and 1860 when Dry Dock 1 was enlarged by nearly 20 percent so that the Navy could repair its fleet, comprised of increasingly larger vessels. To accomplish this enlargement the Navy extended the masonry chamber 65 feet in length at the inland end of the dock. Plans for the work, which would cost about $250,000, were prepared in 1856 and construction commenced in 1858.[44]

The original Quincy granite stones, used to build the head of the dock, were numbered prior to their removal. Workers then reinstalled these stones in their original configuration, though at the new location of the head of the dock, some 65 inland. Only a few of the original stones required replacement. Engineers determined that the soil at the inland extension was hard clay, which could support the stone flooring without the need of a timber pile foundation. This undoubtedly hastened the project and two years after construction began workers

[40] Prior to the construction of the iron-post-and-chain fence, no barriers existed around the dock. After this accident, such barriers were placed around all dry docks. See Carlson, "HSR," v. 2, p. 154.

[41] Among the non-U.S. Navy vessels repaired were the private steamer *Uriel*, the bark *Helicon*, and even a Swedish warship. The Navy Yard received payment for use of the dock; however, in the early 1850s the Charlestown commandant ordered that the rates be raised to discourage this growing trend. Black and Bearss, p. 75.

[42] Brady and Foster, pp. 21-22

[43] This contemporary observation appeared in the *Bunker Hill Guide*, as quoted in Bettina A. Norton, *The Boston Naval Shipyard, 1800-1974*, (Boston: The Bostonian Society, 1975), n.p.

[44] In 1857 Congress tripled the annual appropriation for the Charlestown Navy Yard. The largest item was for $170,000, which was for the start of construction of the dry dock's extension. Black and Bearss, p. 133.

completed the dock's extension.[45] Stone for the new wall sections and flooring for the enlarged chamber was granite, brought from Cape Ann quarries on the North Shore. The granite blocks for the altars were about twice the size of the original blocks; however, the original configuration of the altars was maintained.

Extension of the dry dock required considerable change and repairs to the adjacent paving and drainage system. The annual report for 1858 proposed to procure new stone for the coping around the circular head of the dock, reconstruct surface water culverts and pave the surface with granite blocks. The work progressed on schedule and was completed by 1860. The cobblestones around the dock were replaced by granite block paving at this time.[46]

From Expansion to Reduction, 1861-1890

After the enlargement of Dry Dock 1 was completed in 1860, the number of dockings in the facility increased to nearly 18 per year during the Civil War. Dockings during the two decades after 1870, however, dropped precipitously. On average Dry Dock 1 served only about three vessels each year and there were two years during the 1880s (1885 and 1889) when no dockings were recorded. This drop in activity at the dock reflected an overall decline in shipbuilding work at the Charlestown Navy Yard.[47]

(B8) View of Head of Dock, taken prior to 1907, when the initial modification to the center slide was carried out,. At the time of this photograph the dock's head appeared much as it did following the completion of the extension in 1860.

[45] In 1855, a plan was proposed to increase the size of the dry dock by extending its head inland a distance of 50 feet. A final decision to extend the dry dock by 65 feet was made in 1856 and authorized in the Naval Appropriations Act for fiscal year beginning July 1, 1857. An allocation of $170,000 funded the initial work and an additional $80,000 covered completion in 1858. Brady and Foster, pp. 23-24 & 67-68.

[46] Boston Navy Yard, Annual Report 1858, Record Group 71, Entry 56, Records of Bureau of Yards and Docks, National Archives, Washington.

[47] Black and Bearss, p. 378.

The Navy suspended repair and construction work after 1882, concentrating the efforts of the yard instead on manufacturing goods, most notably rope. On several occasions during these slow times, Congress held hearings to explore the benefits of closing down the yard.[48] The Navy, aided in part by Massachusetts politicians and powerful Boston business interests, blocked such recommendations.[49]

A Renewal of Activity, 1890-1920

Finally, in the late 1880s, Congress appropriated funds for upgrading Dry Dock 1. This included the installation of a new pumping engine to dewater the dock. More significant for the navy yard's operations, however, was the nearly one million dollars that Charlestown received in the 1890s to construct a second and larger dry dock of granite masonry, to the east of Dry Dock 1.[50]

The construction of Dry Dock 2, undertaken between 1899 and 1905, reshaped the operations of the yard's original dock. A new engine house, engines, and pumps now served both docks, and the culverts of Dry Dock 1 were rebuilt to work in conjunction with the new hydraulic and drainage configuration. Dewatering in Dry Dock 1 now took only about 45 minutes.[51] Another significant change was made at Dry Dock 1—the replacement of the heavy timber caisson and turning gates with an all-steel constructed caisson.

In 1901 the Naval Appropriations Act provided $40,000 for a "new caisson for stone dry dock." The $10,000 appropriated in 1897 for new swinging gates was transferred to the caisson project probably because swinging gates were not as efficient as caissons for closing the dock. The new caisson, of steel construction, was fabricated at the Charlestown Navy Yard. Its design allowed it to be floated into position and sunk into place regardless of the tide.[52]

Launched with great fanfare on October 31, 1901, the steel caisson was the first steel hull built at the Charlestown facility. The caisson measured 64 feet long, had a depth of 30-1/2 feet, and contained a maximum width of 18 feet at its base. A contemporary description noted that "the new caisson is a pear-shaped craft, its sides gracefully rounding out from the flat keel and then tumbling home to such an extent that a midships view looks almost like the cross section of a pear."[53]

[48] In 1883 Secretary of Navy William E. Chandler issued orders aimed at ending the repair of naval vessels at Charlestown. This order was largely realized between 1883 and 1890, when the only repair work performed in the dry dock was to the yard's tug. Black and Bearss, p. 378.

[49] For example see "The Navy Yard: The Question of Its Removal Discussed," *Boston Daily Globe*, August 4, 1878; "To Reopen the Navy Yard," *Boston Daily Globe*, November 29, 1885; "Navy Yards: Changes That Are To Be Made at Charlestown," *Boston Daily Globe*, December 22, 1886.

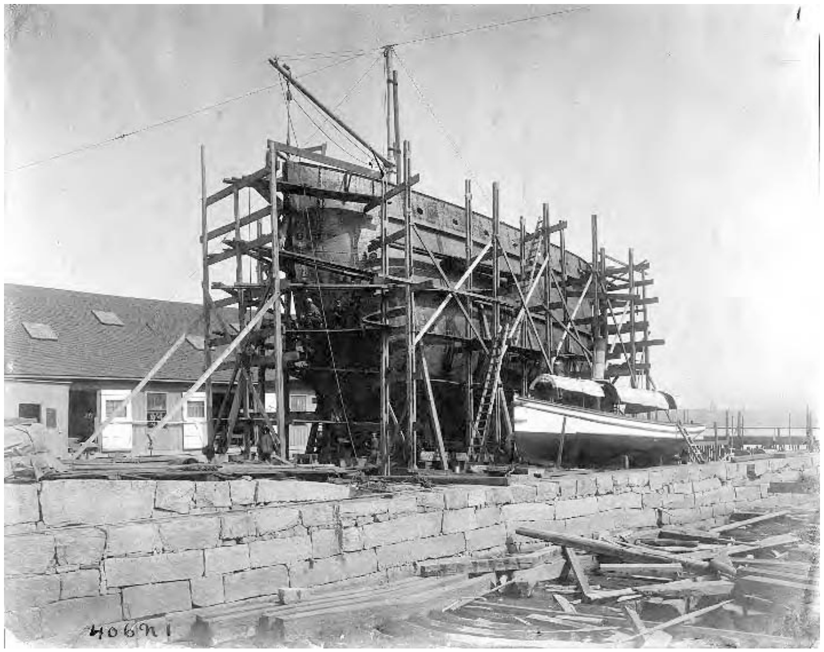
[50] *Charlestown Navy Yard: Boston National Historical Park: Official National Park Handbook 152*, (Washington, DC: National Park Service, 1995), pp. 45-46; Black, *Charlestown Navy Yard, 1890-1973*, v. 1, pp. 197-203.

[51] Black, v. 1, pp. 201-02; Carlson, "HRS, v. 2, p. 159.

[52] Carlson, "HRS," pp. 156 & 164. The old timber caisson could be floated into position and placed into its seat only at high tide.

[53] "Launch of the New Steel Caisson," *Boston Daily Globe*, October 29, 1901.

The steel caisson entered the dry dock on December 27, 1901, for installation of machinery, valves and hardware. As a sealant around the caisson's perimeter "big hempen gaskets"



(B4) The steel caisson under construction in 1901.

were installed along with copious amounts of caulking. The caisson was then placed into service in February 1902.[54]

The steel caisson was not the only change to Dry Dock 1 in the early 1900s. Another alteration, which reconfigured the original dewatering system, was carried out in conjunction with the construction of Dry Dock 2. This change entailed the building of a new culvert that was tied into the new Pump House (Building 123), which would serve to dewater both docks.

Despite some difficulties with the New York based contractor (the bankruptcy of this firm halted the project for a few weeks) a group of navy yard men completed work on the culvert and Pump House in 1905. With the new electric-powered pumps placed in operation, the steam engine and pumps in the original Engine House were subsequently abandoned. In addition, workmen laid tracks for a portal crane, which began serving Dry Docks 1 and 2 in early 1906.[55]

One other modernization effort at Dry Dock 1 occurred at this time when the Hyde Windlass Company of Bath, Maine, received a contract to install three electric-powered capstans. Placed at the dock's head and on either side of the seaward end, these capstans superseded the manually operated capstans and were in working order by the summer of 1905.

The addition of neighboring Dry Dock 2 and improvements to Dry Dock 1 were quickly followed by a growing number of repairs to vessels at the Charlestown Navy Yard. Between 1905 and 1920 nearly 35 dockings occurred each year at Dry Dock 1. In 1918 alone, some 90 dockings occurred at the dock, the most that it would ever experience.[56]

[54] Carlson, "HSR," v. 2, p 156.

[55] Although new boilers and pumps, manufactured by the venerable Southwark Foundry & Engine Company of Philadelphia, Pennsylvania, had been purchased and installed in the early 1890s, this equipment was superseded by the new Pump House operation that began service in 1905. Carlson, HSR, v. 2, p. 156.

[56] Carlson, HSR, v. 2, pp. 155-56.

World War II and Final Expansion

While repair work declined during the 1920s and 1930s, the Second World War brought an unprecedented expansion of operations at Charlestown.[57] To service larger destroyers the Navy altered the head of Dry Dock 1 in 1941, cutting back the center slide.

To improve the movement of vessels into the dock, the Navy replaced the Hyde-Windlass electric-powered capstans with more powerful (20 horsepower) electric capstans. Manufactured by the Modern Engineering Company of Chicago, Illinois, and operating at 440 volts, these three new capstans were installed in 1942.

But the most dramatic change to the original dock was undertaken in 1947-1948 when the seaward end of the chamber was extended by 40 feet. For this work, the Navy contracted with the Coleman Brothers, Inc., a large construction company based in Chelsea, Massachusetts.[58] The design called for steel sheet piles to be driven around the perimeter of the dock with

(B17) View looking west, showing the construction of the circular cofferdams in December 1947.

reinforced concrete used to construct the walls, floor, and caisson seat.

The Coleman brothers commenced work in the summer of 1947, with the driving of steel sheet piling and the demolition of large sections of the original granite masonry work. This was followed by the construction of a series of circular cofferdams a short distance from the new location of the dock's

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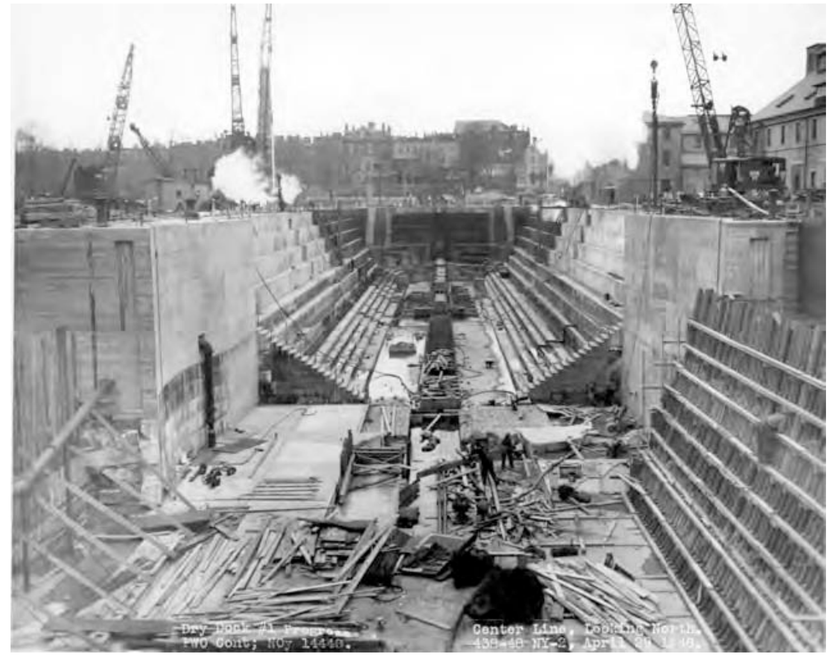
[57] One important project at Dry Dock 1 occurred between 1927 and 1930, which involved the restoration of USS *Constitution*. In the early 1930s the dock was used for shipbuilding with two tugs and one destroyer launched there. Carlson, "HRS," v. 2, p. 157.

[58] This company was founded in the early 1900s by James F. Coleman, the son of Irish immigrants, In the 1910s and 1920s, Coleman's contracting firm constructed tunnels in Boston, as well as roads and railroads in New England. Upon his death in 1930, his two sons, James F., Jr., and William R., took over the company. See obituary of James F. Coleman in *The Hartford Courant*, August 2, 1930; Boston City Directory, 1947.

(B19) Photograph taken in February 1948, during reconstruction of the upper altars, on the west side of the chamber, showing sheet piling and formwork prior to pouring concrete. For about half the length of the dock, reinforced concrete altars replaced the original granite altars.

seaward end. As stipulated in the design, the upper four granite altars along the east and west walls, encompassing a distance of nearly half the length of the dock, were removed and reconstructed with reinforced concrete. These new sections of altars conformed to the dimensions of the original granite altars.



(B21) View of seaward extension of Dry Dock 1, looking north, April 1948.

In addition to removing large sections of the original altars, Coleman Brothers, demolished much of the granite work associated with the turning basin. While the upper levels of these walls were rebuilt with concrete about a half dozen courses of the original stone were retained on the east and west side of the turning basin's walls. All of the concrete work for the 40-foot extension of the new basin, including the seat for the steel caisson, was completed in 1948. The caisson, which had been renovated in 1942, was reinstalled and operated as in former years. Coleman Brothers needed a little more than a year to finish the entire project and Dry Dock 1 now measured 415 feet in length (the dock's current length).[59]

The Post War Years

Dry Dock 1 continued to service Navy vessels into the 1950s, though dockings dropped to about 20 per year, less than one-third of the wartime level. Among the additional improvements carried out during this decade was the construction of a new dewatering tunnel intake, installed in the east wall of the seaward extension. This large tunnel, constructed of reinforced concrete and containing a steel frame across its outlet, was completed in 1960.[60] But the Navy's use of the original dock plummeted over the next ten years.[61]

Conclusion

Although its use declined, Dry Dock 1 was increasingly highlighted for its historical and engineering importance. In 1966 the National Park Service highlighted the dock in its designation of the Navy Yard as a National Historic Landmark. And in 1978, the American Society of Civil Engineers accorded it a National Civil Engineering Landmark. Dry Dock 1 continues to be celebrated as one of the premier historic structures at the Charlestown Navy Yard. Importantly, the NPS commitment to the U.S. Navy to maintain the dock in serviceable condition, has extended the life of Dry Dock 1 for which it was originally intended — to service and repair naval vessels, notably USS *Constitution* and USS *Cassin Young*. Thus, since the NPS administration of the yard commenced in 1974, the dock has retained its status as an active, fully functioning historic maritime structure.[62]

(B29) Taken in 1960, this photograph shows the construction of the dewatering tunnel intake, involving the removal of granite blocks and the building of a concrete-lined tunnel.

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[59] Black, v. 1, p. 206; Brady and Foster, pp. 28-29; Carlson, "HRS,' v. 2, pp. 157-59.

[60] Carlson, "HRS," v. 2, p. 159.

[61] Between 1958 and 1973, the Navy recorded dockings for just one year, 1960, when 10 vessels used Dry Dock 1. See Carlson, "HRS," v. 2, p. 155.

[62] By contrast the dry dock at Gosport is now seldom used for servicing vessels. It remains, however, virtually unaltered from its 19th century appearance, retaining almost its entire granite masonry stonework.

Character Defining Features

As stated by the National Park Service, character defining features "include the overall shape of the building [or structure], its materials, craftsmanship, decorative details, interior spaces and features, as well as the various aspects of its site or environment."[63] The NPS has long recognized that the preservation of these features is a crucial endeavor, one that will allow future generations to explore, interpret, and appreciate the people, culture, or events associated with an historic structure. The character-defining features of Dry Dock 1 have been identified by field inspection and analysis of original historic plans and documents that have been assembled for this HSR.

Except for the original foundation, each of the character defining features is readily identifiable and has been evaluated according to the periods of significance, as noted below. These periods are tied to the major changes that the U.S. Navy has undertaken to Dry Dock 1, over the span of its operation by the Navy. The character defining features of the dry dock are as follows:

1827-1833 Original Construction
- Timber Pile Foundation
- Granite Floor
- Granite Altars and Step-backs
- Head of Dock with Inscription in Granite Blocks
- Granite Stairs
- Granite Slides or Slips
- Granite Coping
- Capstans, Bollards, Bitts, Cleats, and Rings

1856-1860 Inland Extension
- Granite Altars and Step-backs
- Granite Floor

1901-1905 Modernization
- Steel Caisson
- Electric-Powered Capstans
- Dewatering Tunnel

1947-1948 Seaward Extension
- Concrete Floor
- Concrete Altars and Step-backs
- Concrete Stairs
- Propeller Pit

1960 Dewatering Tunnel Intake
- Concrete Tunnel and Steel Grate

Additional Features
- Steel Stanchion and Chain Fencing
- Keel Blocks
- Keelson and Plinth
- Draft gauges
- Steel Platforms
- Utilities

[63] Lee H. Nelson, *Preservation Briefs, No. 17: Architectural Character: Identifying the Visual Aspects of Historic Buildings as an Aid to Their Preservation*, (Washington, DC: National Park Service, U.S. Department of the Interior, n.d.), p. 1.

B. Chronology of Development and Use

As noted above, the significance of the Charlestown Navy Yard lies in its embodiment of both the naval history and the industrial development of the United States from 1800 until its closing in 1974. The structure that best reflects this significance throughout the distinguished history of the navy yard is Dry Dock 1. Its original construction and later development are well documented and remain clearly defined and evident. Indeed, the continuous use of Dry Dock 1 since its completion in 1833 has survived the 1974 closing of the navy yard as it remains an active dry dock and is used to perform periodic repairs to USS *Constitution* and USS *Cassin Young*.

Character Defining Features

1827-1833 Original Construction

Foundation: Dry Dock 1 was built of Quincy granite supplied by engineer/contractor Gridley Bryant. While much of the foundation of Dry Dock 1 is buried and not visible as a character defining feature, it is of fundamental importance. Baldwin's design for overcoming the hydraulic forces that act on shoreside dry dock structures, forcing an empty dry dock to rise and possibly "float" was a critical feature that contributed to its successful use since 1833. While Baldwin's original concept did not call for the dry dock to be built on piles, the Navy's recommendation for the addition of a pile foundation contributed to the success of the design. Consequently, the foundation, although not visible, is included as a character defining feature.

Floor: The stone floor of the dry dock was 5-1/2 feet thick at the head and tapered to 4 feet at the foot of the chamber. Under the turning gates the masonry was 4-1/2 feet thick, while under the miter sill and arches it measured 6 feet.[64] From the lower end of the dock to its semi-circular head there was a rise of 1 foot 3 inches in a distance of 206 feet. The floor was also designed and constructed with a central gutter, one foot in width, extending underneath the keel blocks at the center of the dock, flanked by gutters parallel to the central gutter, also one foot in width, each located near the lower stairs. These gutters carried water to a discharging gutter at the dock's lower (seaward) end.

Altars and Step-backs: Altars are steps or setbacks in the inboard faces of a dry dock. Their function is to reduce the thickness necessary in the upper part of the wall and to increase stability of the wall. In modern dry dock construction altars are kept to a minimum.[65] An exact definition between a step and an altar has not been found in the research done for this report. A military handbook titled *Drydocking Facilities*, however, indicates that the difference is one of height, with a "step" being "low", around one foot in height, whereas an altar is "high" and wider, say two feet or more in height and four feet or more in width.[66]

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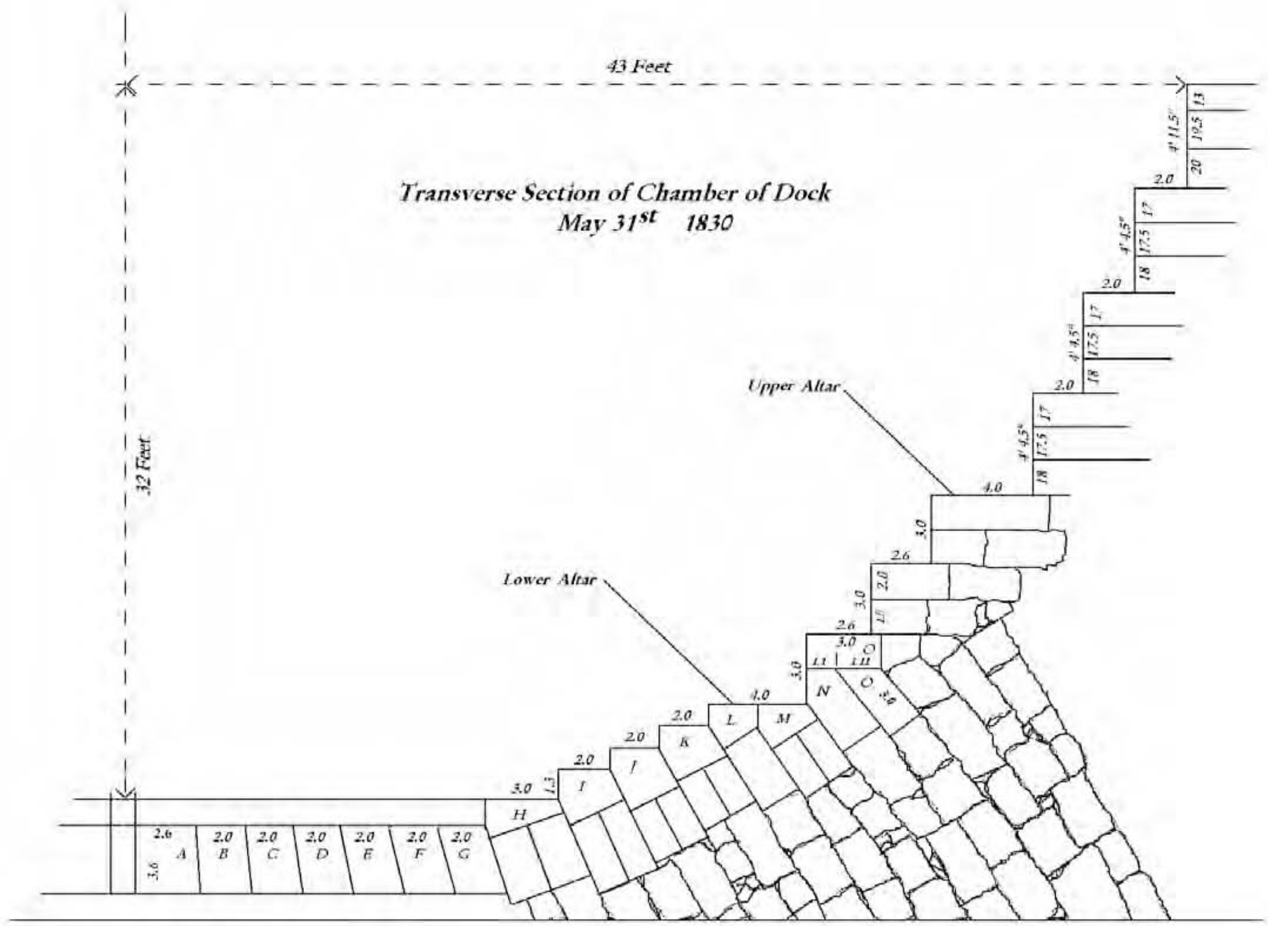
[64] Charles Beebe Stuart, *The Naval Dry Docks of the United States*, (New York: Charles B. Norton, 1855), p. 61.

[65] Stuart, p. 12

[66] Department of Defense, *Military Handbook Dry Docking Facilities Characteristics Military Handbook 1029/3*, (Washington, D.C.: Department of Defense, November 1981), p.12.



(C22) Cross section showing location of altars, redrawn by Robert Stewart from an original drawing in the Loammi Baldwin Collection, William L. Clements Library, University of Michigan.

Charles Stuart's *Naval Dry Docks of the United States* characterizes altars as from 1 to 4 feet high and 4 to 6 feet wide.[67] Using these criteria the Charlestown Dry Dock has two levels of altars. Altars are distinguished from steps by their width, which is 4 feet. The upper altar is 18.08 feet below coping level. The lower altar is 9 feet below the level of the upper altar. A cross section drawing (**C22**) shows the location of altars under these dimensional constraints. According to Brady and Foster the floor of the dry dock was 30 feet wide and 228 feet long between the first altars.[68] This assumes that the first step is an altar. For the purposes of this report, Stuart's criteria are used and the altars are designated as the two 4-foot wide steps.

Head of Dock: The head of Dry Dock 1 was modified several times since it was placed in service. These modifications are discussed (below) under the 1856-1860 inland extension. The original inscription, carved into the granite blocks at the dock's head (see historic photo **B11**), reads:

Commenced 10th July 1827
John Q. Adams President of the United States
Samuel L. Southard Secretary of the Navy
Authorized by the 19th Congress

Opened 24th June 1833
Andrew Jackson President of the United States
Levi Woodbury Secretary of the Navy
Loammi Baldwin Engineer

[67] Stuart, p. 299.

[68] Ibid; Brady and Foster, 15.

Stairs: From the beginning of its operation until about 1950, the chamber of the dry dock was served by three pairs of stairways. The head of the dock contained one pair of stairs (Stairs 3 and 4); a second pair (Stairs 5 and 6) was located near the middle of the dock, on opposite sides of the chamber; and the third pair (Stairs 1 and 2) was located on either side of the seaward end. A plan of the dock **(C20)** shows the original location of the stairs. Unlike the dock at Gosport, the stairs (5 and 6) at the middle of the chamber at Charlestown did not extend below the upper altar. An historic photograph (**B10**) shows a wooden stairway here, extending down the lower altars, and not granite stairs, like those constructed at Gosport. During the 1947-1948 seaward extension, the original granite used in the construction of these stairs was removed and replaced with concrete. Soon after, the openings to Stairs 5 and 6 were closed, with heavy timber planks covering the openings across the coping level.

(B6) Detail from historic photograph from 1913, showing the opening at the coping level to Stair 5, on the east side of the dock.

(B10) View of Dry Dock 1, from 1930, looking northwest, toward the head of dock, with the turning basin in the foreground. Note that at the middle of the dock, on the west side, a wooden stairway was located above the lower altars and provided access to the dock's floor.

Similar to the stairs at the middle of the dock, the upper flights of Stairs 1 and 2 at the seaward end were rebuilt with concrete as part of the 1947-1948 seaward extension. However, the original granite stairs of the lower sections, extending down the lower altars, were retained. This condition remained unchanged until the construction of the dewatering intake tunnel on the east side. At that time the last part of original granite of Stair 1 was demolished and a new relocated stairway of reinforced concrete was built. Stairs 1 and 2 were both rehabilitated to OSHA Standards in 2004.

Slides or Slips: Materials could be transported into the dock on granite slides or slips. These are steep inclined planes ranging from 30 degrees to 60 degrees from the horizontal. **Drawing C24** shows elevations, primarily their angle with the horizontal, of the timber slips. The center slip at the head of the dock, now removed, was 5 feet wide from top to bottom with a landing at what Baldwin termed a "broad altar."

Coping: Coping is the top course of brick or stone on a wall. In Dry Dock 1 the coping is comprised of granite blocks set in cement on the side walls of the dock forming their edges. Some of the coping blocks are additionally fastened with "dogs" or iron pins. The coping is considered a decorative element with the regularity of placement of the granite stones sharply delineating the shape of the dry dock.

Capstans, Bollards, Bitts, Cleats, and Rings: The original capstans were hand-powered vertical winches used to open and close the turning gates at the head of the dry dock. They also provided the power to position vessels over the keel blocks.

Fig. 1 View of hand-powered capstan on the east side of the dock at the seaward end. This is one of two surviving *in-situ* hand-powered capstans.

The original capstans were replaced at an unknown date, though probably in the late-19th century. Two of these hand-powered, late-19th century capstans remain in place and are located near the seaward end of the dock. The two other capstans that were located at the head of dock were removed. The barrels of these two capstans are now located at the southwest entrance of Building 24 and serve as decorative elements. The installation of three electric-powered capstans in

1905 was part of a larger modernization effort of the dry dock in the early 1900s. In 1942 these three electric-powered capstans were replaced with newer electric-powered capstans, manufactured by the Modern Engineering Company of Chicago, Illinois.[69] As part of the 1947-1948 seaward extension two of these capstans were relocated to the south. Each was covered with a wood-frame gambrel-roof shed. The two that sheltered Capstans 1 and 3 were removed and wood-frame shed buildings were constructed. The shed covering Capstan 1 was removed after collapsing, while part of the other one that sheltered Capstan 3 remains standing, but is severely dilapidated. The wood-frame gambrel that covered Capstan 2 (see **B11**) was removed at an unknown date after 1974.

Fig. 2 View of Capstan 2 at the head of dock. This is one of three electric-powered capstans dating from 1942.

Along either side of the dry dock and located to the outer side of the portal crane tracks are a series of bollards (steel or iron posts that are used to attach mooring lines.) There are six bollards on either side of the dock, extending from the head to the seaward end. These are not the original bollards, but likely date from 1906 or later, after the crane tracks were installed. On the caisson are two sets of bitts (steel or iron posts—shorter in height than bollards, that are also used to attach lines). Each of the two pairs of bitts probably date from the original construction of the caisson.

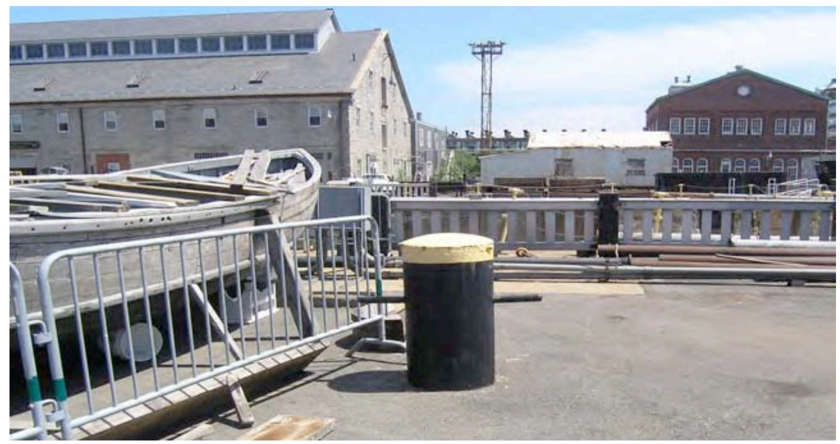


Fig. 3 View of Bollard near the seaward end.

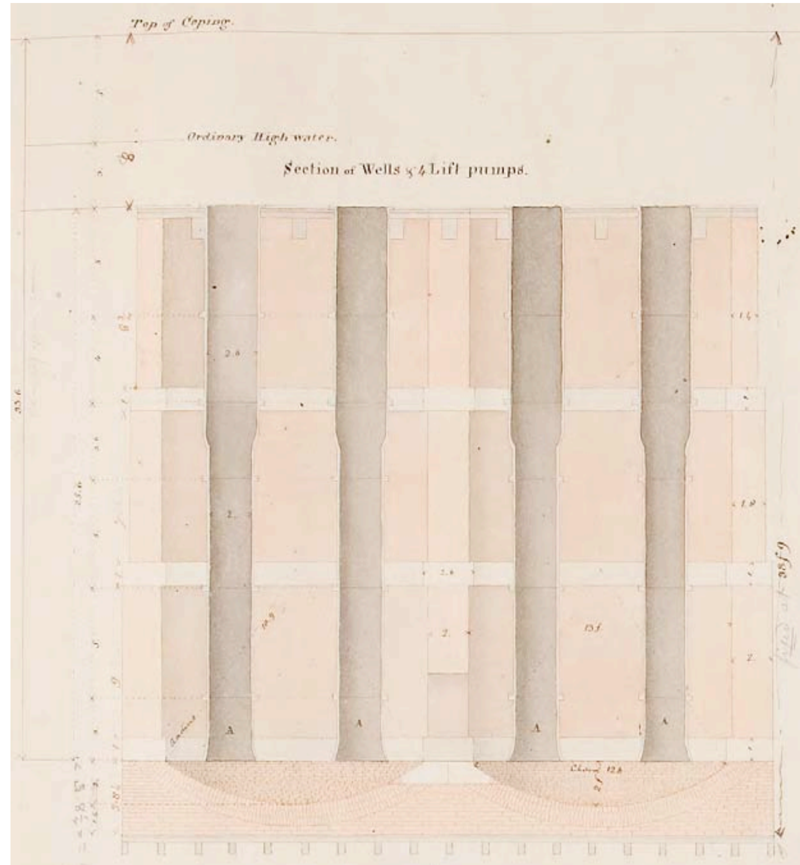
Iron cleats, also used for securing lines, are located in pairs on either side of the dock at the seaward end. These were likely installed in the late 1940s as part of the seaward extension of the dock. The caisson also contains a group of 10 iron cleats, likely dating from the original construction of the caisson.

[69] Carlson, "HRS," v. 2, pp

From its original construction through the 20th century, iron rings for securing lines have been attached to the dock's walls, floor, and coping stones. Approximately 55 rings are located along the dock's east side and approximately 40 rings are on the west side.

Fig. 4 Detail of iron rings along west wall of dry dock

Wells: Wells serve as sumps for the pumps and are considered a component of the pumping system located in the engine house. A drawing (**C38**) by Alexander Parris in 1840 shows the relationship of the engine house to the connecting tunnel and dry dock. As shown in the detail from an original drawing (**C16**) the wells were brick cylindrical structures 15 feet 9 inches in diameter with a bottom formed as an inverted arch or dome. The well walls were 2 feet 6 inches thick. Projecting courses of cut stone supported the pump frames. The tops of the walls were surfaced with a stone coping 1 foot deep and 18 inches wide.[70] The great wells were completed in November 1831. These were located in the engine house and were the sumps housing the suction side of the pumps.



(C16) Detail from original drawing "Section of Wells & Lift Pumps," from an original drawing in the Loammi Baldwin Collection, William L. Clements Library, University of Michigan.

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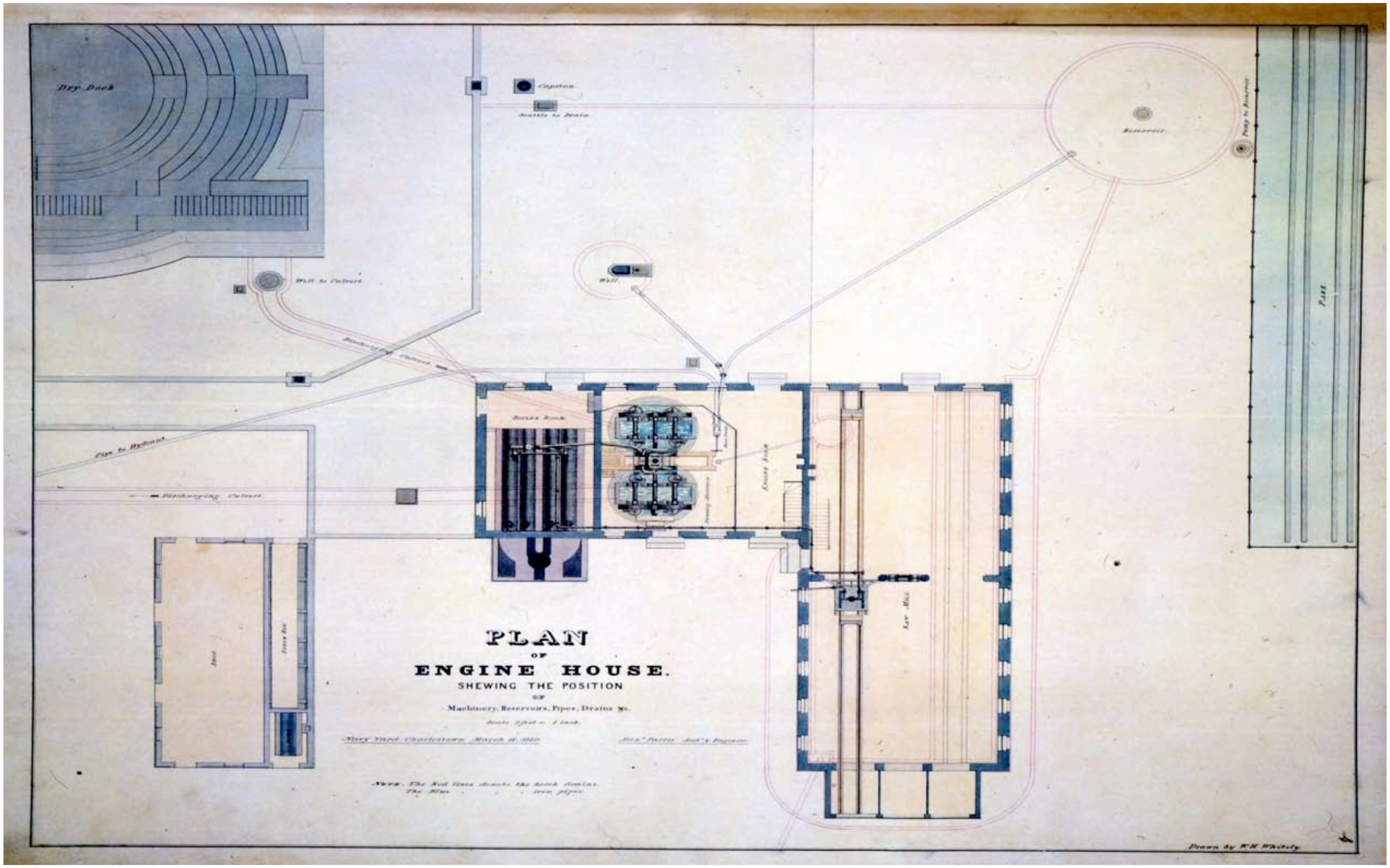
[70] Ibid, 62.



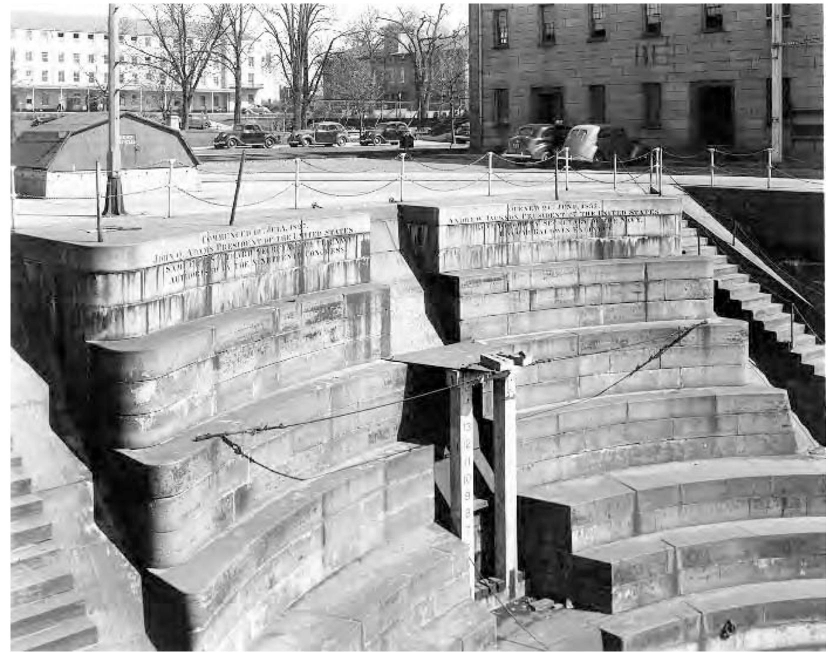
(C38) "Plan of Engine House Shewing (sic) the Position of Machinery, Reservoirs, Pipes, Drains & c.," March 11, 1840.

1856-1860 Inland Extension

When completed in 1833, Dry Dock 1 was large enough to hold the largest ship commissioned in the U.S. Navy. By the 1850s, however, larger ships were being built and dry docks had to be extended to accommodate them. Plans to extend the head of the dock by 65 feet were executed in 1855 and work commenced the following year. A drawing (**C25**), adapted from original drawings, shows the major changes to the head of the dock over time.) Analysis of the ground under the proposed extension showed it was very hard clay, sufficiently dense to support stonework without piles. Stonework was laid directly on the clay base.

The original masonry at the head of the dock had hardened and the use of small charges of powder facilitated loosening the stonework. The head of the dry dock was disassembled carefully; each stone was numbered and recorded on a set of architectural drawings, dating from the 1850s. The stones were then reassembled 65 feet inland, following their original 1830s configuration.[71]

Stone cutting technology and handling equipment had improved significantly since the dry dock was first built and by mid-century it was possible to cut and transport larger stones.



(B11) Photograph taken in 1939, showing the upper altars at the head of the dock. The original inscription was carved into the granite blocks of the uppermost altars. All of these stones were removed and reassembled as part of the inland extension, completed in 1860. The gambrel-roof structure just beyond the lightpole was the shed that covered Capstan 2.

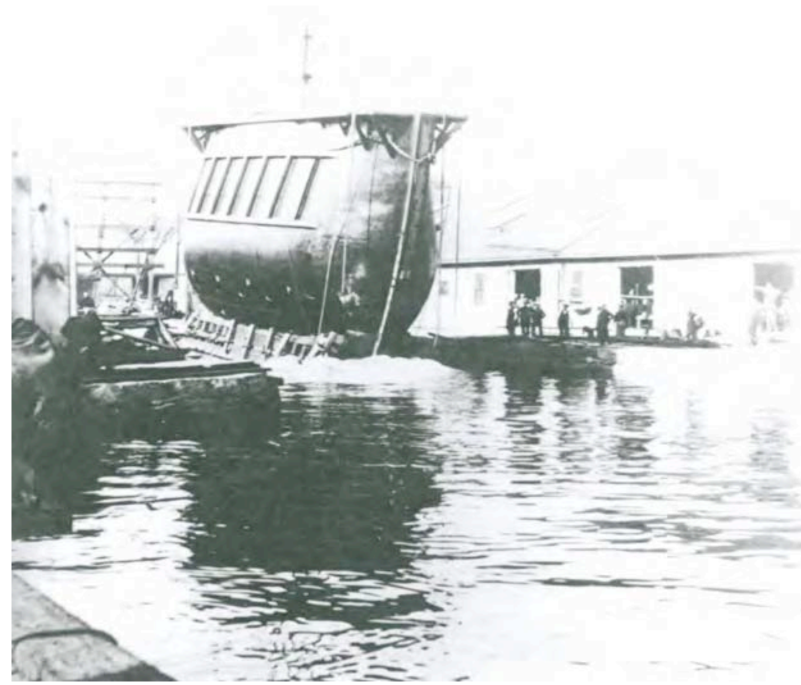
Accordingly, granite blocks used in 1857 are twice as thick as the earlier blocks. New work courses are about 35 inches while the older stones formed courses of 18 inches. New stones measure up to thirteen feet in length while older stones range

[71] The U.S. Navy prepared a series of architectural drawings in advance of the inland extension construction. See “Proposed Plan for Extending the Dry Dock at the U.S. Navy Yard, Boston,” July 23, 1856, 12 sheets of drawings, Drawings BOSTS 13448. For the numbering of the stones see “Isometrical View of Dock Head,” n.d. [ca. 1857], sheet 9 of 12, Drawing BOST 13448; Isometrical Projection of Half of Head of Dry Dock, United States Navy Yard, Boston,” n.d. [ca. 1857], sheet 12 of 12, Drawing BOSTS 13448.

from four to six feet.[72] Much of the stonework was fastened by lewising.[73]

Extension of the dry dock required considerable change and repairs to the adjacent paving and drainage system. The annual report for 1858 included the proposal to procure new stone for the coping around the circular head of the dock, reconstruct surface water culverts, and pave the surface with granite blocks. The work progressed on schedule and was completed by 1860. The cobblestones around the dock were replaced by granite block paving at this time.[74]

Cape Ann granite was principally used for extending the dry dock rather than the Quincy granite used in the original construction.[75] The material used in the coping was taken from the Quincy quarries.



(B5) The steel caisson at its launching in 1901.

1901-1905 Steel Caisson and New Pumps

Fabricated at the Navy Yard in 1901, the steel caisson replaced the heavy timber caisson and turning gates. Its most intensive use occurred during the two world wars and in the early years of the 1950s. In 1964 an engineering study indicated that the caisson was in poor condition and its replacement was then considered. The Navy proposed the construction of a new caisson, but did not receive funds for this project. When funds were not forthcoming the Navy resumed its regular maintenance of the caisson until the yard was closed.

[72] Ibid, Brady & Foster, 68.

[73] Lewising is a method of attaching a lifting eye or bolt to a stone. It may also be used for holding stones together. In lewising, a dovetailed iron tenon, made in several pieces, is fit into a dovetailed mortise or recess cut in the stone. Matching mortises on two stones may be fastened with a device having two tenons. Charles M. Harris, *Dictionary of Architecture and Construction*, (New York: McGraw-Hill, Inc., 1883), p. 487.

[74] Boston Navy Yard, Annual Report 1858, Record Group 71, Entry 56, Records of Bureau of Yards and Docks, National Archives, Washington.

[75] A detailed description of Quincy granite, quarrying, and transportation can be found in Brady and Foster, pp. 62-67.

The caisson was reportedly completely rebuilt in 1977.[76] Since the National Park Service assumed management of the site only four vessels have used the dry dock. In 1991 the caisson was overhauled at an East Boston shipyard and reinstalled prior to the docking of USS *Constitution* in September 1992, when repairs were undertaken to the historic frigate in preparation for its 200th birthday. SS *Nobska* entered Dry Dock 1 in 1996 and the caisson has not operated since that time. In 2006, SS *Nobska* was demolished and removed from Dry Dock 1, which is currently empty. With periodic overhauls and modifications the caisson continues in service. It is the oldest steel vessel built at the Charlestown Navy Yard.[77]

1907 Center Slide Modification

In 1907 a minor alteration to the head of Dry Dock 1 allowed clearance for slightly larger ships. The center slide was cut back 3 feet 8 inches to clear the bow of vessels.[78]

1941 Head of Dock Modifications

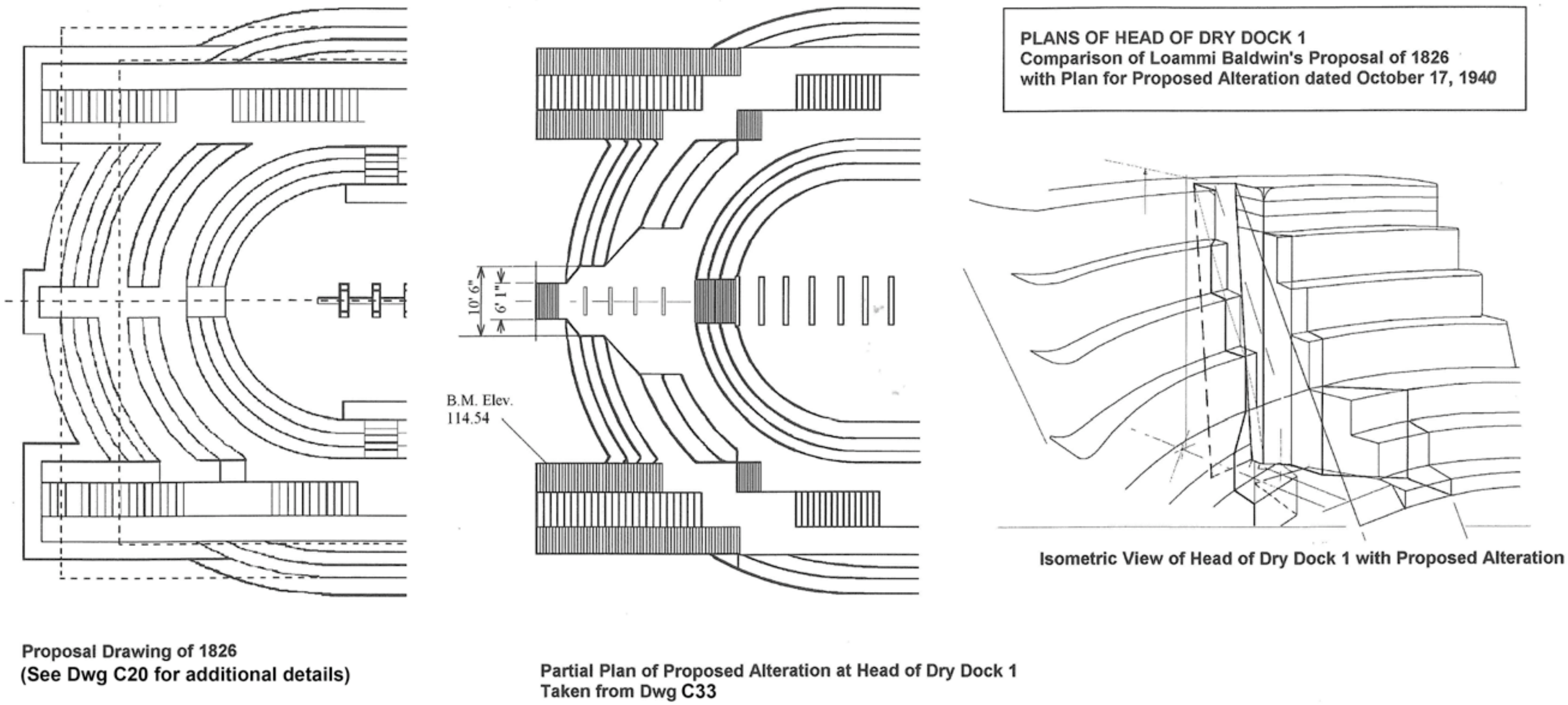
The U.S. Navy initiated plans to modify the head end of Dry Dock 1 in 1940 to accommodate longer vessels. The following year work began, resulting in a substantial alteration to the head. Most notably this entailed the removal of the center slide except for two granite blocks at the floor of the dock, along with the removal of the broad altar at the base of the slide. In addition the altars on either side of the center slide were cut back. These changes significantly altered the appearance and character of the head of dock. The smooth horizontal lines and curvature of the granite blocks gave way to an incised vertical appearance of rough granite edges and exposed concrete at the head of the dock (**B13**). The modifications are shown in a drawing (**C25)**, which documents the major changes to the head of dock.

(B13) View in 1946 showing the opening where the center slide formerly stood and the cuts made to the altars on either side of the slide. At the center slide, the spaces between the remaining granite blocks (which formed the backing) were later infilled with brick and the blocks, except for the lower one, were covered with concrete.

[76] Brady and Foster, pp. 29-30.

[77] Carlson, “HRS,’ v. 2, p. 156.

[78] Drawing Sheet 3230, “Proposed Alteration in Forward End of Dry Dock 1,” Navy Yard Boston, June 19, 1907.



(C25) Plans and isometric drawing by Robert Stewart, adapted from original drawings, showing the original configuration of the dock's head and the major alterations to the center slide in the 20th century.

(B22) View in 1948 of seaward extension, looking south. Note that the new concrete altars conformed to the dimensions of the original granite altars.

1947-1948 Seaward Extension

The quarterly inspection of the dry dock during March 1947 revealed that the side walls had bulged inward at the stairwells in the center of the dock. Blocks on the west wall between the fourth altar and coping had moved as much as 4 inches out of alignment. Somewhat less movement was noted on the east wall. At this time the need for a larger docking facility was manifest and a second extension of the dry dock was planned.

Plans specified that the granite wing walls were to be removed and the dock extended seaward. Some of the granite side walls were removed and replaced with reinforced concrete. Bulkheads consisting of steel sheet piling were driven at the new entrance of the dry dock. In the area at the middle of the dock (around Stairs 5 and 6) the contractor reconstructed the side walls. After demolishing the granite blocks and excavating out the original rubble backfill, a reinforced concrete retaining wall was constructed. In the chamber of the dock the demolished altars were replaced with reinforced concrete altars.

This replacement encompassed the upper four altars below the coping level and extended nearly half of the dock's length. Below Altar No. 4 grouting was pumped under pressure to consolidate the rubble masonry. Additional work included the partial removal of the granite miter sill of the floor and its replacement with a 6-inch concrete floor liner. The dimensions of the new concrete altars were identical to those of the original granite altars (see **B22**).

The dock's extension also required the relocation of the seaward, electric-powered capstans. Coleman Brothers performed this work in the summer of 1948, building new reinforced concrete capstan pits, which housed the electric-powered driving mechanisms, and installing steel watertight covers (see **B24**).

Also, in the late 1940s the steps that arced around the dock's floor at the head of dock were removed and a low concrete wall was built in place of the steps. (The steps are visible in **B13**; the low concrete wall is visible in **Fig. 6**—see page 45.)

(B24) Photograph taken in July 1948, showing relocated Capstan 3, including the capstan barrel, which rests on top of the newly constructed capstan pit.

Within the arc of the turning gates, a new 18-inch concrete floor liner was poured. A depression in this new floor was formed to accommodate propellers.[79] Sheet pile cells were driven on either side of the dry dock's outboard end and the capstans relocated over these cells. These modifications resulted in the extension of the dock to its present overall length of 404 feet, an extension of approximately 40 feet. In 1961 further modifications expanded the propeller pit by increasing its width.

[79] Carlson, "HRS," v. 2, p. 159.

1960 Dewatering Intake Tunnel

In the late 1950s the U.S. Navy sought to improve the integrated dewatering system that served Dry Docks 1 and 2. For Dry Dock 1 this entailed the construction of an enlarged concrete culvert that tied into the existing brick culvert, which in turn was connected to the Pump House (Building 123). This alteration replaced the outlets in the floor and side walls with a direct opening through the east wall. As seen in a photograph (**B29**), demolition of granite blocks along the east wall, at the old turning basin, was begun in the summer of 1960 and workers completed the new intake tunnel in the fall. The intake contained a steel-frame across the opening. When the new dewatering system was completed, Dry Dock 1 could be drained in 45 minutes, instead of the 75 minutes previously required.[80]

In addition to building the intake tunnel, workers relocated the adjacent granite stairs (Stair 1) several feet to the north. The original stairs were demolished (historic photograph **B7** shows the original granite stairs in the late-19th century) and the new stairs were built of reinforced concrete.

Additional Features

Steel Stanchion and Chain Fence

In 1851, the U.S. Navy erected an iron post and chain fence at the coping level around the perimeter of the dock (see **B2**). The current steel stanchion and chain fence dates from around 1930.

[80] Carlson, "HRS," v. 2, p. 159.

Keel Blocks

Originally heavy timbers were used as keel blocks, which required continual replacement as a result of structural cracking, weathering, and rotting. The keel blocks currently in the dry dock are of post-1940s vintage and are composed of concrete, with some containing timber blocking. (For a more detailed accounting of the type and sizes of these keel blocks see the “Keel Blocks” in the “Physical Description” section of this report.)

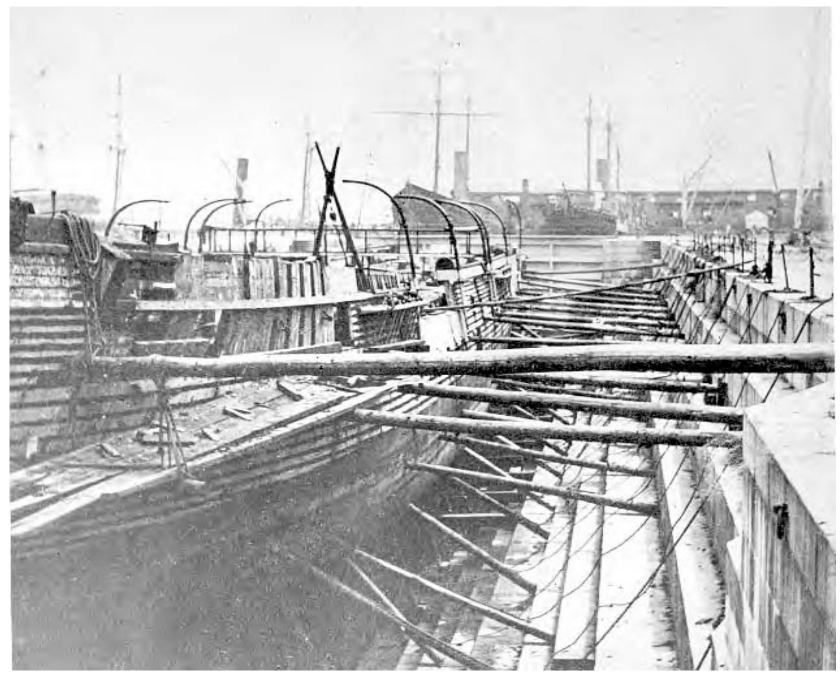
Keelson and Plinth

Extending longitudinally the length of the dock along its centerline, the keelson of Dry Dock 1 has been altered over the years. Around 1930 concrete blocks (or ties) were installed and formed the dock’s keelson (historic photograph (**B10**) was taken when the installation of these blocks was nearly completed). Remnants of these concrete blocks, extending from the dock’s head to mid-chamber, are extant. The seaward extension in 1947 and 1948 resulted in the removal of a part of the keelson. In the 1950s or 1960s the Navy installed a concrete plinth to raise the keel blocks off the dock floor, thus providing more working room between the hulls of vessels and the floor. This increased height allowed Dry Dock 1 to improve the service of vessels containing such elements as sonar domes.[81]

Shoring

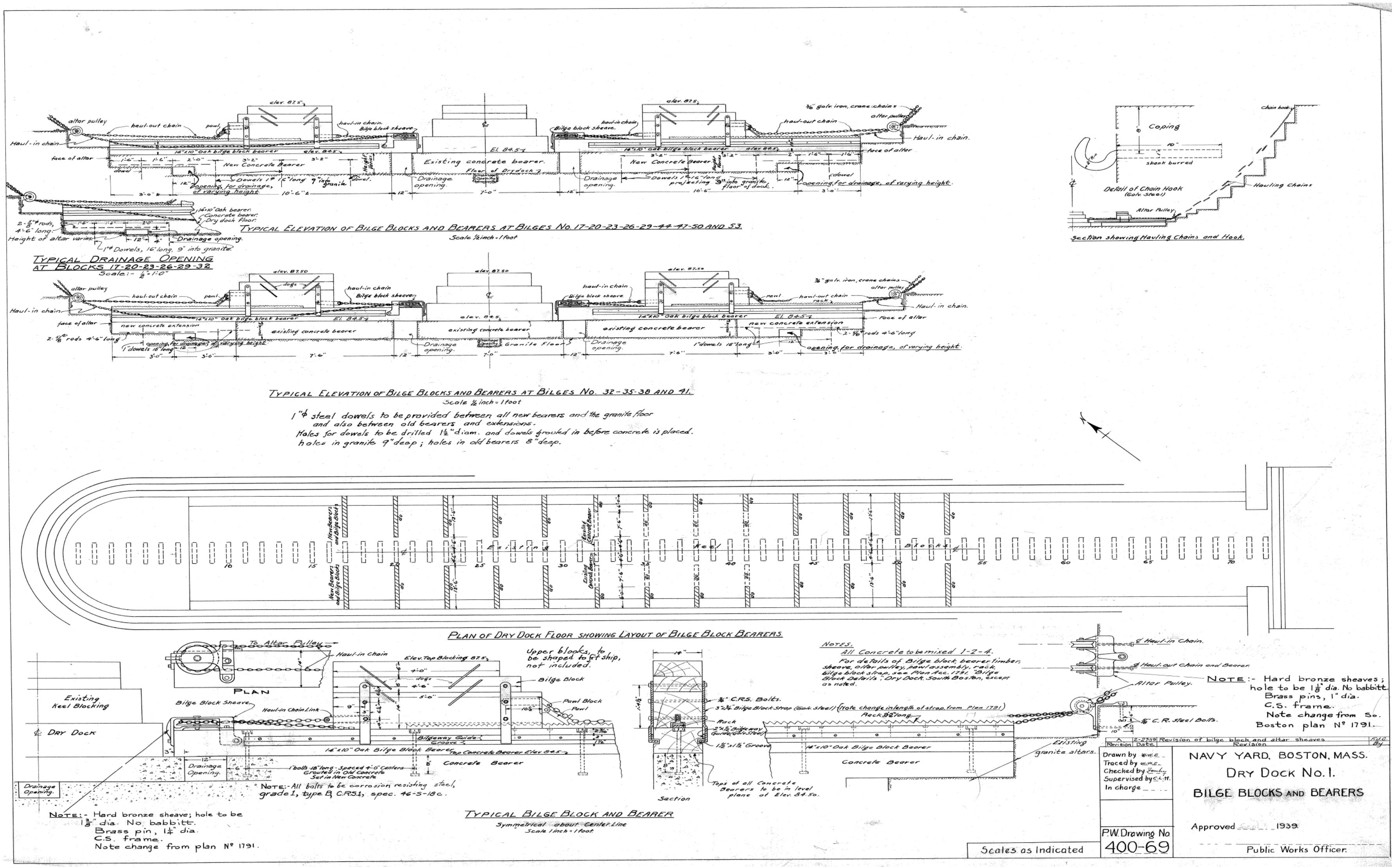
Shoring, trammels, bilge, and side blocks are props, usually made of wood that are individualized to each ship and the imprecise variants of its hull form and positioning. These props are positioned between the walls, steps, altars or floor of the dry dock and the ship’s hull in order to stabilize its position while it is being worked on. Historic photograph (**B2)** shows the shores used on a ship docked in 1854.

A drawing (**C32**), produced in 1939, details an extensive system of bilge blocks that could be moved by means of chains, sheaves and altar-mounted pulleys, all of which could be powered by the capstans, and arranged to conform to the shape of a ship's hull. A ratchet and pawl device on each bilge block bearer locked the block in the desired position. There is no evidence of any extant shoring or bilge blocks in the dry dock.



(B2) View, looking south, of a vessel and timber shores in the dry dock, 1854. Note the iron post-and-chain railing at the coping level on the right side of this photograph.

[81] Carlson, “HRS,” v. 2, p. 156.



(C32) This U.S. Navy drawing, dating from 1939, shows the layout and detail of bilge blocks and bearers. The bilge blocks and bearers were removed at an unknown date and there is no longer any evidence of their operation in the dry dock's chamber.

(B7) View of one of the draft gauges of Dry Dock 1 in the late-19th century. This gauge was adjacent to the original seaward stairs (Stair 1) on the east side of the dock.

Draft Gauges

Draft gauges are scales positioned vertically on various sections of the dock's walls. They serve to indicate the height of water in the dock especially during the critical period when positioning the vessel over the keel blocks prior to contact.

Steel Platforms

There are five structural steel platforms, each with steel grate floors. The Navy installed three of these platforms in the 1950s. The steel platforms on the west side supported various

Fig. 5 View of steel platform on west side of the dry dock.

utilities, as well as equipment used for the repair of vessels. Of these three, the largest two measure approximately 14 feet by 5 feet and are located on the east side of the dock, one near the dock's head, the other near the seaward end. The third platform from the 1950s, measuring approximately 10 feet by 5 feet, is located along the west side of the chamber, midway between the head and the seaward end.

Two small platforms, erected in the early 1990s, each measure approximately 5 feet by 3 feet. One is next to the large platform at the seaward end, while the other is next to the large platform near the dock's head. At least one of the larger steel platforms (at the northeast end of the dock) replaced an earlier timber-constructed platform (**B13**) erected at an unknown date.

Steel brackets support the steel platforms; each platform extends out from the dock's coping and projects over the upper

(B13) Detail from a photograph taken in August 1946, showing granite stairs (Stair 4) on the east side of the head of the dock, Located above the stairs is a wooden platform, replaced in the 1950s with a steel platform. Note the absence of fixed utility lines that were installed a few years later along with the steel platforms.

altar. They were probably fabricated in one of the yard's metal shops and installed by Navy Yard workers. The three largest platforms contain metal post and chain railings; the small platforms have a metal pipe railing. Although these structures are wholly utilitarian and do not possess any design significance, they reflect functional needs of ship repairs into the 1950s and 1960s, as they permitted easier access to the decks of vessels in the dry dock.

Fig. 6 A nearly identical view of the stairs and platform on the east side at the head of the dock. Note the addition of steel brackets, supporting electrical cable lines, and utilities that run along the east side of the dock.

Utilities

Apart from pipes carrying water for fire suppression and various uses for servicing vessels, Dry Dock 1 had few fixed utility lines until World War II. During the 1940s and 1950s, however, a number of utilities were installed, including improved electric cable lines, and new pipes for water and compressed air. Most of these lines, along with steel brackets that supported them, were installed along the dock's east side. These utilities reflect the modernization of the dock in the 20th century.

C. Physical Description

The overall length of the dry dock, from the head of dock to the inner face of the caisson, is 415.31 feet. The clear widths of the dry dock at the top of the coping stones are 86.1 feet and 30.1 feet at floor level. The physical description herein is based upon visual field inspections, as well as from a recently prepared condition assessment of Dry Dock 1.[82]

Floor

The original granite floor and the granite floor of the 1856-1860 inland extension of 65 feet appears to be in excellent condition with little or no settlement. (The fact that there is little settlement indicates that the original foundation is likely in good condition.) Three lines of granite gutters, each 11 inches wide, extend the length of the original dock. At sections of the center gutter there has been some infilling with concrete. In addition, all three gutters are covered with concrete at the head of dock. Sections of the gutters are also silted in or filled with debris.

Fig. 7 View of floor at head of dock, showing the concrete slab and concrete ties that extend along the centerline of the dock.

At the head of dock, a reinforced concrete slab, measuring 36 feet in length and extending the full width of the dock floor, overlays the granite floor. A series of concrete blocks, which are the remains of a keelson, extend along the centerline of the dock a distance of approximately 60 feet (see below, “Keelson and Plinth”). About half these blocks rest on top of the concrete slab, the other half rest on the granite floor. The concrete floor of the 1947-1948 seaward extension is in fair condition except in the propeller pit area where it is severely cracked in random patterns and joints are in poor condition.

In the 1950s and 1960s various changes were carried out to the floor, including the cutting of sections of the concrete slab, to enlarge the propeller pit (**Fig. 8**), and the installation of a reinforced-concrete plinth to increase the clearances for servicing vessels with sonar domes (see section below, “Keelson and Plinth”).

[82] Whitman, Requardt & Associates, LLP, “Dry Dock No. 1 Study, Boston National Historical Park, Boston, Massachusetts, Condition Assessment Report,” February 27, 2004. Hereinafter this report is referred to as the “WR&A Report.”

Altars and Step-backs

When the dry dock was extended 65 feet inland (between 1858 and 1860), the granite blocks that comprised the head of dock, stairs, coping, and a portion of the walls were removed and reassembled at the new head of dock location in the exact same arrangement as the original construction.

The infill for the new 65-foot section of the chamber was constructed with Cape Ann granite with blocks almost twice the height of the original blocks. The original and mid-19th century sections are distinctive, clearly identifiable features of the dock (**Fig. 9**).

The granite blocks that comprise the altars and step-backs are in excellent condition except for a few blocks that have chipped edges or cracks where holes have been drilled for iron or steel appurtenances that have rusted and jacked. The blocks are generally level and straight except in areas of the two granite stairs at the head of dock where there has been some movement of blocks at the lower level.

There is little evidence of wall movement or depression. An inspection performed in 1947 revealed that some of the granite blocks of the side walls had bulged inward as much as 4 inches. The upper four altars of about half of the length of dock's side walls were removed and replaced with concrete replicating the original form. Much of this concrete work is in fair to good condition, although there is some cracking and spalling, most notably on the east side of the chamber near the seaward extension.

Fig. 8 Detail of propeller pit and cuts made in the granite stone at the seaward end of the dock

Fig. 9 View looking northwest toward the head of dock. Along the west side of the chamber, from left to right, may be seen the three major construction periods of Dry Dock 1. At left are the concrete altars from 1947-1948; adjoining these concrete altars are the original altars of Quincy granite; the large blocks to the right are composed of Cape Ann granite, used to construct the altars as part of the inland extension completed in 1860.

Fig. 10 Detail of cracked and broken granite block in step-back along the west wall that has been repaired with concrete.

Fig. 11 Detail of vegetation, missing grout, and deteriorated mortar in joints of the lower altars on the west side of the chamber. This condition is prevalent throughout the dry dock.

This work was undertaken in conjunction with the 1947-1948 seaward extension. Grout and mortar are generally in poor condition with little sound grout remaining between blocks. This has resulted in large, deep gaps between the blocks. Throughout the chamber, vegetation is growing from the gaps between the masonry blocks as well as from mortar joints and cracks in the stone.

Fig. 12 View looking north showing the east side of the chamber. The lower altars and stairs of granite were retained, while the upper altars were replaced with reinforced concrete nearly half the length of the dock.

Stairs and Slides

Three pairs of stairs provide access to the dry dock. Stairs 1 and 2 are located on the east and west walls near the seaward end and extend down to the dock floor. At the head of the dock, on the east and west sides, are Stairs 3 and 4. Parallel to each of these stairways is a pair of slides of massive granite blocks. These stairs and slides are primary features of Loammi Baldwin's original design and they continue to provide access to several altars all the way to the dock floor. The slides are in excellent condition and the stair blocks are generally in good condition except for several that were have chipped edges and where granite blocks exhibit movement at the bottom of each stair.

Fig. 13 Lower flight of Stair 3, on west side near the head of dock. Note that the three step-backs of the arc at the head of dock have been removed and replaced with a concrete wall that is now deteriorated.

Near the middle of the dock are Stairs 5 and 6, opposite each other on the east and west sides. These extend down only to the second broad altars. The original granite stairs were

Fig. 14 Lower flight of Stair 2, on west side near the seaward extension. This original section of stair was preserved as part of the 2004 repairs of Dry Dock 1.

Fig. 15 Detail of blocked entrance to the chamber of Stair 6, near the middle of the dock.

demolished and replaced with reinforced concrete at the same time that the seaward extension was under construction. The Navy closed off access to these stairs, probably in the late 1940s. The entrances to Stairs 5 and 6 were covered with timber decking (see **Fig. 15**), supported by timber posts, resting on the concrete stairs (see **Fig. 16**). The timber decking is in fair condition and the stairs remain blocked off.

Stairs 1 and 2 extend from ground level down to the floor of the dock. As elements of the original dock these stairs were entirely granite until the 1947-1948 seaward extension. During this construction the Navy removed the granite of the upper

Fig. 16 Detail of entrance to the chamber of Stair 6, near the middle of the dock on the west side. One of the timber posts that supports the timber planking, which blocks off the ground-level entrance to the stairway, is visible in the center.

flights of Stairs 1 and 2 and rebuilt them with concrete. The granite of the lower flights of Stairs 1 and 2 were retained. In 1960, as part of the construction of the new dewatering tunnel intake, the lower flight of Stair 1 was demolished and a new flight of stairs to the north was constructed with concrete. The lower flight of Stair 2 was unaltered.

By 2000, the concrete of Stairs 1 and 2 was seriously deteriorated and four years later these two stairways were rehabilitated to provide OSHA compliant and safe access to all levels of the dock. This work included replacement of all deteriorated concrete steps. The lower flight of Stair 2 was retained with the stonework reset and repaired, and all mortar joints cleaned and repointed. New railings and security gates were installed for Stairs 1 and 2.

A number of the surviving granite stairs have steel post and chain railings, which are in very poor condition and do not meet OSHA standards. Granite blocks that have moved need to be reset to uniform treads and risers, all joints require re-grouting and repointing, and railings need to be code compliant.

Coping

The coping includes the original 1832-1833 granite coping at the head of the dock, the 1856-1860 granite coping of the inland extension, and the concrete slab installed around the perimeter of the southern one-third of the dock as part of the 1947-1948 seaward extension (see **Fig. 19**).

On the west side the original granite coping is generally in good condition (see **Fig. 18**) and, with the exception of some

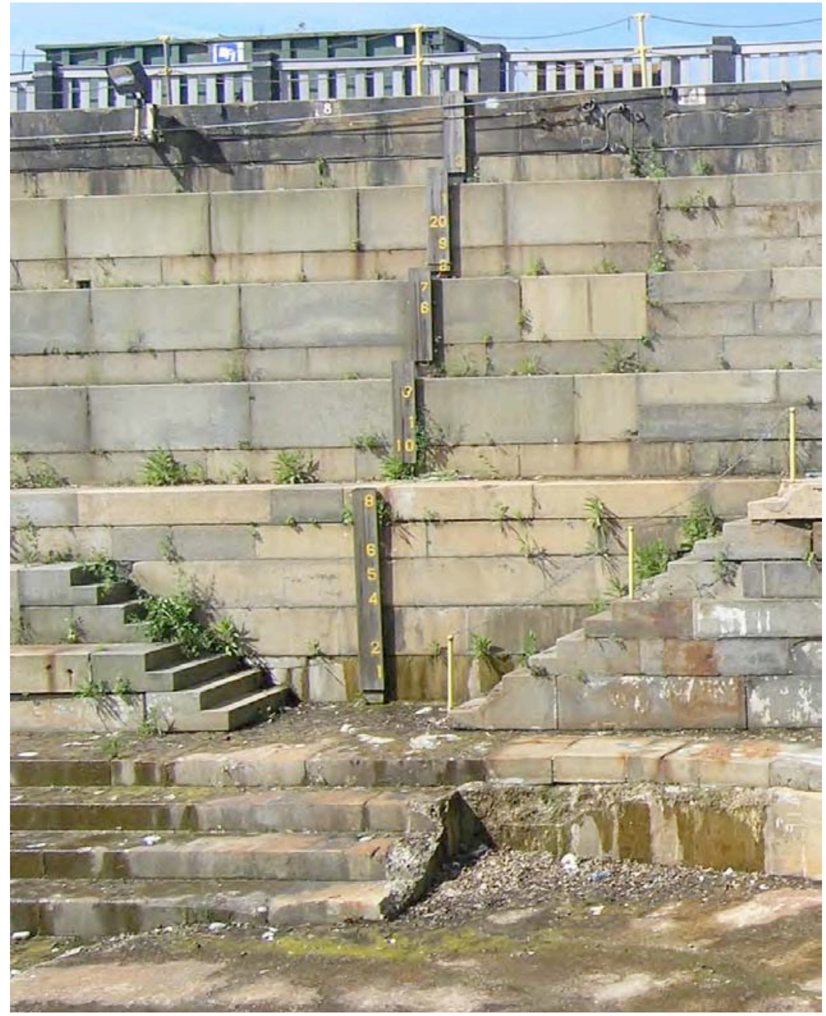


Fig. 17 Granite stairs at lower altars, west side of the chamber. Note that some deterioration has occurred in the lower steps (at lower right) where a section of the lower steps, extending around the arc of the dock's head, were removed and replaced with a low concrete wall that is now in poor condition.

Fig. 18 Detail of coping on the west side near the head of the dock, where the original granite remains in place.

coping has been patched more extensively with concrete or asphalt. Similarly the granite coping at the middle sections of the dock on the east and west sides is largely intact with some concrete patching. The concrete slab that was poured at the coping level as part of the seaward extension is in fair condition.

Some granite was probably removed during construction of the seaward extension and replaced with concrete. In general, there are numerous utility, grates and steel platform components including many rusted pieces that surround the granite coping and concrete slab around the perimeter of the dock.

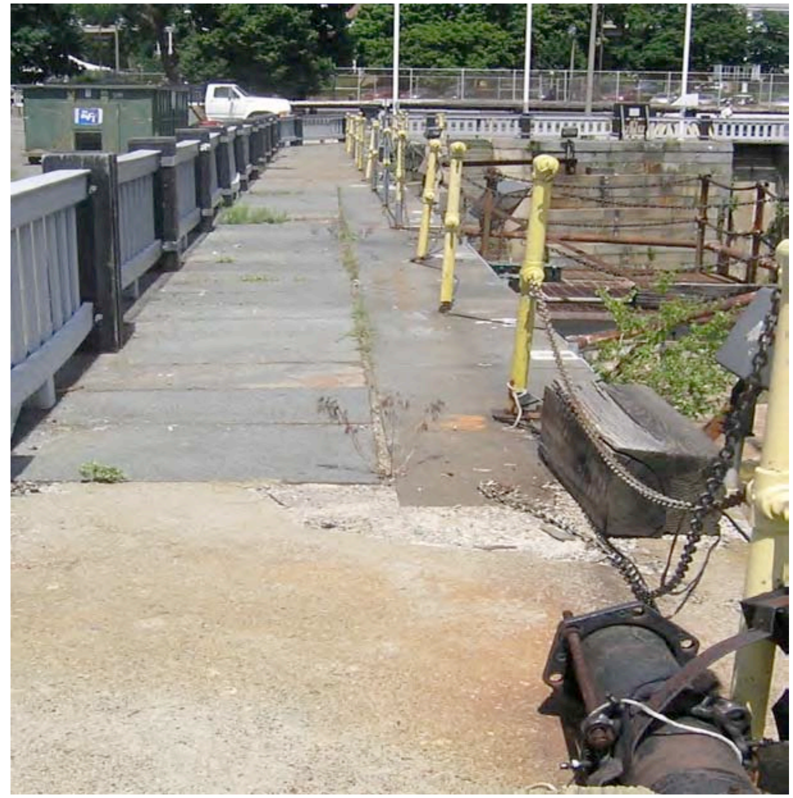


Fig. 19 View looking north, along west side of dock showing the coping from three different time periods. In the foreground is concrete slab (late 1940s); abutting the concrete is granite (from the ate 1850s); and beyond, around the head of the dock, is the original granite coping.

Fig. 20 View of head of dock showing alterations to center slide and lower stairs to the dry dock floor.

Head of Dock

The 1856-1860 extension moved the head of dock inland by 65 feet but the granite blocks were reassembled in their original configuration.[83] This included the granite stones containing the original inscription. In 1907 the center slide was partially cut back by 3 feet 8 inches to provide clearance for slightly larger ships. Even more drastic was the complete removal of the center slide in 1941 to accommodate larger vessels. The granite altars on either side of the slide were also cut, with the

[83] Drawing BOST 134487-400 Sheets 9 and 12 Isometrical Projection of Half of Head of Dry Dock.

upper and lower altars cut at 45-degree angles.[84] Some years later the granite that provided the backing to the original slide was reconstructed with brick and a concrete facing. While all of this work does not appear to have affected the structural integrity of the head end, its present appearance is inconsistent with the original design. Consistent with the side walls, altars and step-backs, the granite blocks of the head of dock are in excellent condition except where they were cut back during the 1941 alterations. The grout and mortar are generally in poor condition with numerous gaps between the joints. The original inscription cut into the granite blocks is partially stained and with some of the letters and numbers cracked. Spanning the opening of the removed center slide is timber planking that is in poor condition. In addition, vegetation is growing between the joints in the coping stones

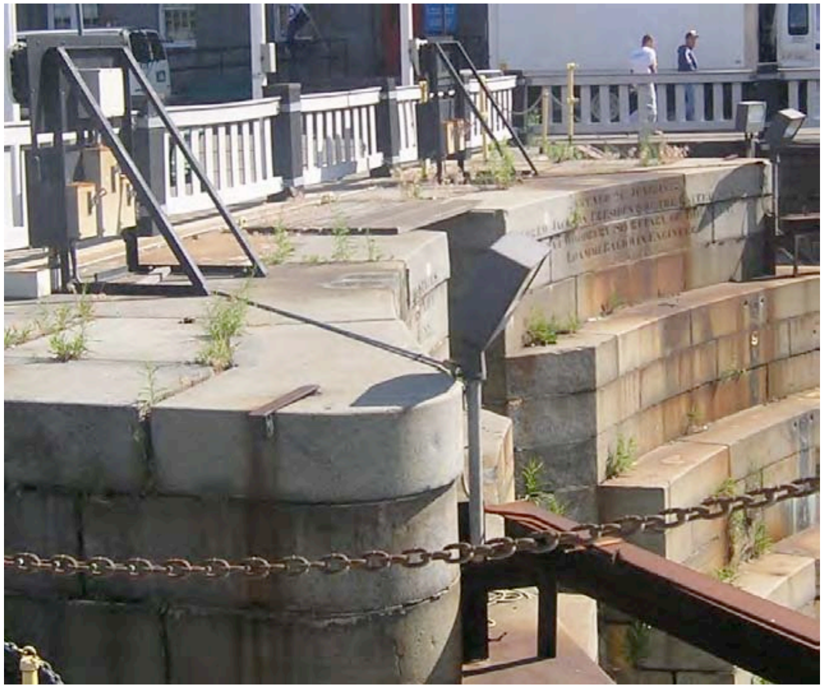


Fig. 21 On top of the head of dock are visually intrusive, non-historic utility boxes (mounted on steel frames) and electrical lines. The timber planks spanning the removed center slide are deteriorated and unsafe. Two iron rings from the 19th century remain in place, as do two small steel pulleys mounted to steel bars.

Steel Caisson

The steel caisson was built at the navy yard in 1901 and placed in service in February 1902. It is the oldest steel vessel built at the navy yard. The caisson was inspected and evaluated in 2004 as an element of the WR&A Condition Assessment Report based on U.S. Navy criteria in MIL-STD-1625(C) to evaluate dry docks for certification.[85]

The caisson is currently flooded and seated with the “A” dryside facing the chamber and the “B” wet side facing the harbor. It has been in this position since 1996 when SS *Nobska* was drydocked. The main level (machining deck) was in fairly good condition and very little active corrosion was found on the gate’s interior.

[84] “DRYDOCK No. 1: Proposed Alterations at Head, “ October 17, 1940, [Drawing BOST 134487-400 Sheet 71], Boston Naval Shipyard Architectural Drawings, Boston National Historical Park Archives, Charlestown, MA.

[85] WR&A Report, p. 16.

Fig. 22 View of the steel caisson, looking south.

Some rust was evident in isolated locations at floor-to-wall connections but overall the paint coating was clean. The heaviest corrosion was isolated in the southwest corner of the machinery deck where leakage through some rivet holes collected on the floor. Lower levels of the gate were not inspected since it was flooded. The seals (seat) of the caisson appear to be largely watertight; however, when the caisson is overhauled the structural elements that constitute the seat, as well as the gaskets that prevent leakage, should be thoroughly inspected and repaired as required.

No cracks were evident in the steel from a visual inspection of the dry, inside of the gate. Ultrasonic thickness measurements

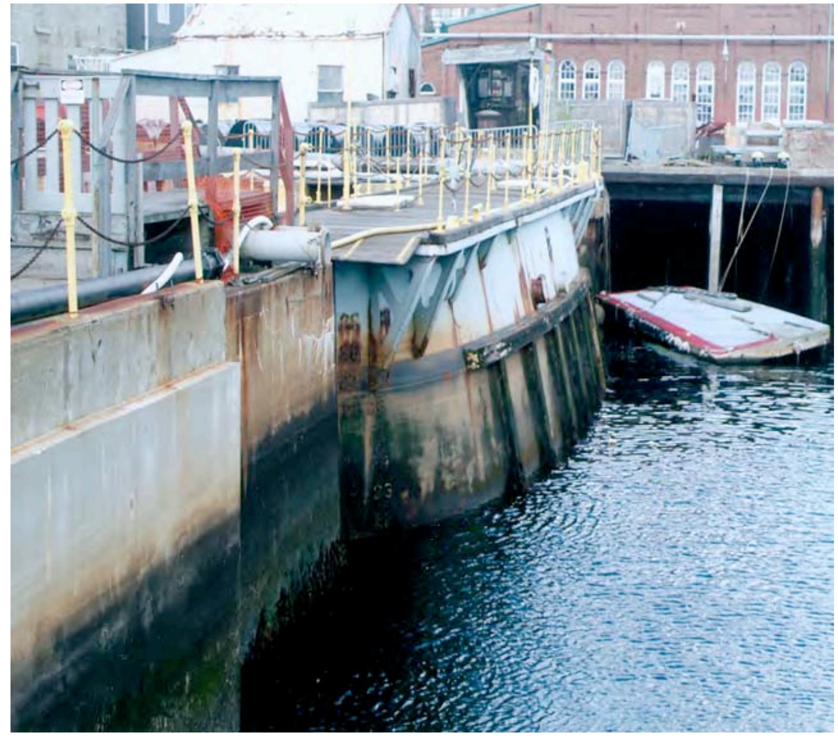


Fig. 23 View of the steel caisson on the seaward side.

were taken of the hull plating and compared with the original thicknesses which revealed that several areas of both sides have a greater than 25% reduction. In general, the entire lower half of the wet side exhibits corrosion beyond the 25% threshold, which is the limiting criterion for dry dock certification by the U.S. Navy.[86] All sections of steel plating that are less than 75% thickness will require replacement or double plating. Mechanical equipment (including pumps and

[86] WR&A Report, pp. 26-28.

Fig. 24 Granite floor and keel blocks, looking south toward the steel caisson.

valves), electrical equipment, seals, and wood decking should be repaired or replaced as necessary and the installation of a cathodic protection system is recommended.

Since the caisson has been flooded for the past 11 years a complete and thorough inspection, as well as testing work, could not be performed. However, some substandard conditions have been noted and additional deterioration and defects are anticipated. All repairs should be designed by a welding engineer and all of the reconstruction work should be executed in a manner that maintains the integrity of this historic vessel.

1947-1948 Concrete Seaward Extension

All concrete installed as part of the seaward extension is in fair to poor condition. Engineering inspections and evaluations undertaken in 1979 and again in 2003 determined that there are no serious leaks but there are numerous cracks and extensive efflorescence.[87]

Pattern cracking and crazing exists in isolated but large areas of concrete sections of the altars. Core samples and field testing determined that four areas of concrete altars are severely deteriorated and that surface concrete that has pattern cracking and crazed cracking be removed and replaced with new concrete.

There are several major cracks in the concrete side walls at the caisson end of the dock. While some crack repairs were made after 1979, the WR&A field inspection found little evidence of these repairs. In fact, the cracks identified in 1979 have worsened and spalling has increased.[88] This deterioration will accelerate with increased water penetration and the effects of freeze-thaw action.

Fig. 25 View of the west wall, showing the condition of the concrete. This was part of the work carried out for the seaward extension in 1947-1948. Note that some of the lower courses of granite, which date from the original construction of Dry Dock 1, that were retained. The rusting steel pipe and valve structure in the center was part of the improved hydraulic system installed at the time of the seaward extension.

[87] WR&A Report, pp. 17-18.

[88] WR&A Report, p. 17.

Fig. 26 View of east wall of the 1947-1948 seaward extension, showing deteriorated concrete work. The lower courses of granite that were part of the original turning basin were retained.

1960 Dewatering Tunnel Intake

This large intake culvert represents the Navy's last major construction effort of Dry Dock 1. Completed in 1960, it eliminated the older dewatering system of floor drains and smaller outlets in the chamber's walls. As seen in **Fig. 27** the culvert contains a steel frame at its intake.

A number of years ago the tunnel into which the culvert connects was sealed off and the dewatering is now accomplished with six (Barnes Manufacturing Company) diesel-powered pumps mounted on timber skids. Suction hoses extend from the coping level down into the dock's chamber and the pumps discharge through two steel pipes located on either side of the dock, above the grade of the coping, and extending to the river.[89]

Fig. 27 Detail of tunnel intake and steel frame across its entrance.

Crane Tracks

The 20-foot gauge crane track system that served both Dry Dock 1 and Dry Dock 2 is still intact around Dry Dock 1 but is in poor condition. Two inoperable portal cranes, originally used by the U.S. Navy, are located on either side of the dock.

[89] For more on the current operation of dewatering Dry Dock 1 see WR&A Report, pp. 11-12.

Fencing Surrounding the Dry Dock

A steel stanchion and chain fence, which dates from World War II, is located along the edge of the coping to protect workers from falling into the dry dock. This fence is in fair to poor condition with missing sections. Beyond the stanchion and chain fence is a public safety fence/guardrail comprised of wood posts and a composite railing, which extends around the dock's perimeter.

During the U.S. Navy's operation of Dry Dock 1 there was no need for fencing around its perimeter, other than the existing stanchion and chain fence. With the closing of the yard and its inclusion into the Boston National Historical Park the dry dock became accessible to the general public. For safety reasons the NPS erected a modern low-level fence/guardrail around the dock, several feet behind the older stanchion and chain fencing.

Fig. 28 View of safety fencing, with wood posts and composite railing, at head of dock, looking northeast. In the foreground is the older stanchion and chain fence, with the stanchions painted yellow.

This new safety fence/guardrail is made of a composite plastic material (from recycled materials) and attached to wooden posts with metal brackets. Although in fair condition, the composite railings are beginning to sag from their own weight and the long-term durability of this fence/guardrail is questionable.

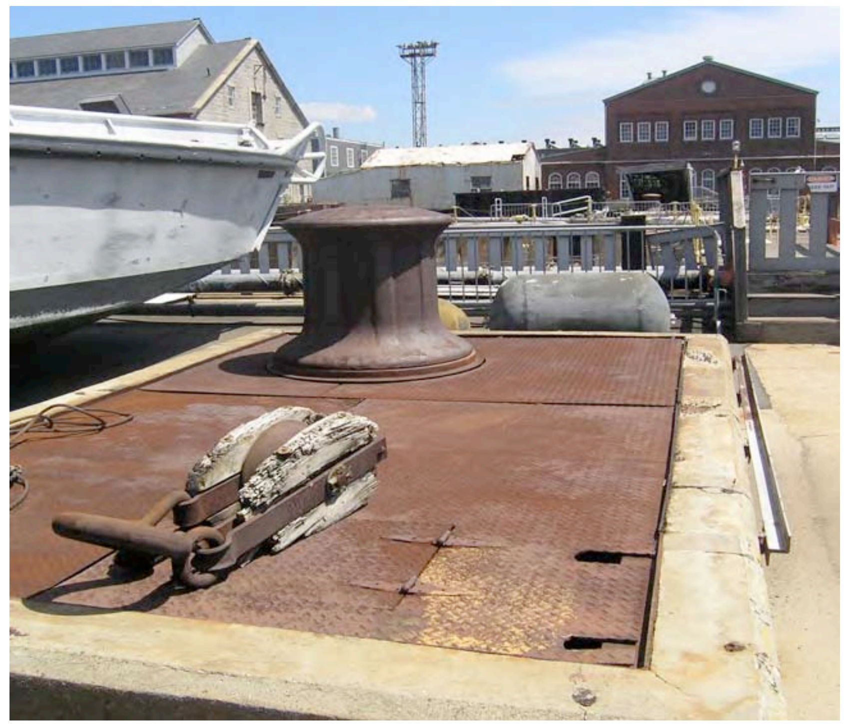


Fig. 29 One of three electric-powered capstans; this one is on the on west side of the dock at the seaward end.

Capstans, Bollards, Bitts, Cleats, and Rings

Among the key features of Dry Dock 1 are the capstans. Two of the capstans are hand-powered and date from the late-19th century. These two are located on either side of the dock, near the original turning gates, and were used to open and close these gates. There are three electric-powered capstans, all dating from 1942. One of these (Capstan 2) is located at the head of dock. Capstan 1 is on the west side at the seaward end, and Capstan 3 is on the east side, opposite Capstan 1. All of the electric-powered capstans were originally sheltered by gambrel-roof, wood-frame structures, though none of these survive. The driving mechanisms are housed in reinforced concrete pits, below the capstan barrels.

As part of the 1947-1948 seaward extension, two of the electric-powered capstans (No. 1 and No. 3) were relocated to the south. These two capstans are severely corroded and in need of repair. The steel plates that span the reinforced concrete capstan pits are severely deteriorated and in need of replacement. The concrete pits, however, are in good condition.

Capstan 3 is partially enclosed by a wood-frame structure that is in a dilapidated condition. None of the capstans are operable but all five are significant features of the dry dock and its operation. In addition to these five capstans, two capstan barrels, which probably date from the late-19th century and were likely among the hand-powered capstans of Dry Dock 1, serve as decorative elements for one of the doorways to the adjacent Building 24.

Fig. 30 Capstan No. 3 on the dock's east side near the caisson gate, looking east. The dilapidated wood-frame structure, which contains electrical panels, partially encloses this capstan.

Flanking either side of the dock is a group of iron bollards filled with concrete. There are six bollards on the east and west sides of the dock and these extend from the head to the seaward end. They appear to date from the early 1900s. The steel caisson contains two sets of bitts, each dating from the original construction of the caisson.

Iron cleats, also used for securing lines, are located in pairs on either side of the dock at the seaward end. These were likely installed in the late 1940s as part of the seaward extension of the dock. The caisson also contains a group of 10 iron cleats, likely dating from the original construction of the caisson.

Also used for securing lines are iron rings, some of which date from the 19th century. There are approximately 100 iron rings, a number of which are severely deteriorated.

Keel Blocks

The 98 keel blocks in the dry dock are composed of reinforced concrete and are of three different sizes. “Type A” keel block measures 48 x 42 x 40 inches and there are 56 of this type. “Type B” measures 48 x 42 x 16 inches and there are 30 of this type. “Type C” measures 72 x 72 x 33 inches and there are 12 of this type.

Although the concrete of most of the keel blocks is in good condition, about 15 blocks exhibit cracking and spalling of concrete. Most of the steel U-bolts, which are embedded in the concrete and permit the moving of the blocks, are missing or severely corroded. This deteriorated condition of these U-bolts substantially limits the use of the keel blocks. Moreover, a number of the keel blocks contain rotten timber blocking attached with steel tie downs.

Keelson or Plinth

At the centerline, a series of concrete blocks, seven feet wide at the head, and tapering to six feet in width, extend a length of approximately 60 feet. These concrete blocks constitute the remnants of a keelson, installed around 1930. About half these blocks rest on top of the concrete slab, the other half rest on the granite floor.

Fig. 31 View of concrete keel blocks showing the three different types of blocks.

The concrete plinth, constructed in the 1950s or 1960s, is approximately 20 feet long and 5 feet wide. The marking plate is inscribed in the concrete, with the numbers ranging from 66 to 72, along the side of the plinth. The plinth extends along the centerline of the dry dock, near the original turning basin, and rests on the granite floor. It is in good condition.

Draft Gauges

There are eight draft gauges at strategic locations in the dock to measure the depth of water in the dock especially when lowering the water level to position a ship over the keel blocks. Some of these gauges are mounted over older wood gauges that are attached to the masonry walls. Two gauges at the head of

Fig. 32 Detail of draft gauge [file Dry Dock 8/10/05; #6612]

dock are painted directly on the face of the granite blocks. Two wood gauges are mounted to the altars of the side walls at the base of the stairs at the head of dock and two gauges, one wooden and one painted, are located on the concrete walls near the propeller pit. Two additional gauges are composed of brass numbers embedded in the concrete walls of the seaward extension. All of the gauges are in deteriorated condition with many faded or missing numbers.

Steel Platforms

Two large work platforms, of structural steel with steel grating and metal post-and-chain railing, are located on the east wall. A third work platform, similarly constructed of structural steel and with a metal post-and-chain railing, is located on the west wall.

Fig. 33 Work platform, east wall, near seaward end. Note the abandoned utility lines and boxes on the platform.

Steel struts supporting these platforms are deteriorated; the most severely deteriorated is at the seaward end on the east wall.

Two small viewing platforms are located along the east side of the dock and are adjacent to the larger work platforms. Also of steel construction, the viewing platforms contain steel pipe railing and are in fair condition.

Utilities

Dry Dock 1 contains a number of exposed utility lines, including steel pipe for a compressed air, a steel pipe carrying water for fire suppression, and electrical cables for lighting the dock, as well as for operating the caisson and providing electricity for repairing vessels. There are 27 lights that extend around the dock's perimeter to light the dry dock chamber. Each consists of a 400-watt, metal halide floodlight. These lights are connected to the same electrical feeder that feeds the steel caisson and were probably installed in the 1980s.

Most of the older utility lines are located along the east side of the dock at or near the coping level. A series of steel brackets, numbering approximately 65 and attached to the uppermost altar, extend along the east side of the chamber. These appear to have carried electrical cables and about a half dozen of these brackets are severely rusted.

Fig. 34 View of pipes, electric cable, and floodlights along the west side of the dock.

D. Evaluation of Integrity

The major construction periods of Dry Dock 1—from the original 1827-1833 erection; to the 1856-1860 head extension; to the 1901-1902 steel caisson installation and 1947-1948 seaward enlargement—are evident today and constitute much of the historic fabric of this landmark structure. In addition, a number of other alterations, such as the deepening and concreting of part of the dock's floor to create a propeller pit, along with a range of maintenance and repair efforts, have occurred over the history of Dry Dock 1, encompassing the years of the U.S. Navy's operation of the yard up to the more recent period of NPS ownership.

Some of the routine maintenance work has included repointing mortar, repairing masonry, patching spalled concrete, and rehabilitating the caisson gate, as well as installing new electrical and fire suppression systems, and compressed air and steam lines. Moreover, some of the modernization work has resulted in significant changes to the original dry dock design, most notably in the hydraulic and mechanical pumping system in which the dewatering operation of Dry Dock 1 was integrated with that of Dry Dock 2, following the completion of the latter dock in 1905. Taken together, however, these alterations and additions are all critical elements of the operation of Dry Dock 1 over its historically significant life span and also provide visual evidence of changing marine and civil engineering technology.

Thus, the guiding principle in evaluating the integrity of Dry Dock 1 is that the extant historic fabric from the original construction of the dock, as well as the structural, mechanical, and hydraulic elements, which stem from the major additions and improvements carried out in the 19th century up to about 1960, reflect the U.S. Navy's active use of the dock.[90]

In general, the most important architectural elements of Dry Dock 1 include: (1) the granite masonry work, seen in both the original construction and the 1858-1860 head of the dock extension; (2) the steel caisson, especially its curved steel hull and bulbous base; and (3) the concrete work from the 1947-1948 seaward extension. While the physical material and visual character of each of these elements derives largely from civil and marine engineering designs that were predicated on functional requirements, such as the need to withstand static loads or hydrostatic pressures, they also constitute the most significant architecture of the dock.

As will be seen in "Part 3: Treatment and Use" of this Historic Structure Report, this effort has evaluated Dry Dock 1 and formulated recommendations for its preservation or rehabilitation within the framework of four principal categories: (1) Those elements that constitute the major structural, hydraulic, and mechanical components of the dock over its active use by the U.S. Navy, and figure most prominently in the dry dock's historical and architectural integrity; (2) Those elements that, although secondary features, are important character defining features reflecting, again, the dock's active operation; (3) Elements or alterations which, though minor, detract from the dock's historical integrity; (4)

[90] Although the landmark status relating to civil engineering has been tied to Baldwin, his design, and the dock's original construction and function, the nationally important U.S. Naval operation of the dock over its lifetime has been highlighted, as well, in the dock's National Historic Landmark designation. See the "NHL Nomination" and the *ASCE Guide to History and Heritage Programs*, p. 31.

Major alterations or additions that dramatically detract from the integrity of the dock's original design or its character defining features that evolved over the lifetime of the dock's use by the U.S. Navy.

PART 3 | TREATMENT AND USE

A. Ultimate Treatment and Use

Introduction

The design, construction, and operation of Dry Dock 1, from its inception in the early 19th century to its current use today, encapsulate a nationally prominent history. Contributing to this visually impressive work of engineering are the dock's major structural, marine, and architectural elements, which are identified in Section 2 of this report, under the heading of "Character Defining Features." As highlighted below, the preservation of these key components is critical to maintaining the historical integrity of this landmark structure.

The assessment of the condition of the dry dock's character defining features stemmed from four field inspections conducted in 2006 and 2007.[91] In addition, the consultant drew upon two engineering studies, the most recent of which was produced by Whitman, Requardt & Associates.[92]

Guiding the recommendations in the "Ultimate Treatment and Use" section are several important documents connected to the dry dock's operation and preservation.[93] In the "General Management Plan," (1980), the National Park Service declared that the most significant historic structures in the Charlestown Navy Yard are to be preserved to permit "to the greatest degree possible the appearance of an active navy yard…with naval and maritime activities encouraged in the yard." The NPS included Dry Dock 1 in its list of "structures of greatest historical significance." To these structures the NPS mandated "preservation of the first order," meaning that "only minimal alteration or modification to the historic fabric" was to be permitted. The "General Management Plan" also called attention to the loan agreement between the U.S. Navy and the NPS, concerning USS *Cassin Young*, in which Dry Dock 1 was to remain in serviceable condition to accommodate "at the Navy's expense" the periodic docking of USS *Constitution*.[94]

Thus, Dry Dock 1 requires a preservation treatment that maintains the long-term integrity of it key historical features, while accommodating its use in the future as a functioning docking facility.

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[91] In addition to the field inspections for this HSR, McGinley Kalsow & Associates carried out field work at Dry Dock 1 in 2004 and 2005 in connection with the analysis and redesign of the stairs at the dock's seaward end.

[92] Whitman, Requardt & Associates, LLP, "Dry Dock No. 1 Study, Boston National Historical Park, Boston, Massachusetts," February 27, 2004. The other study is Department of the Navy, Naval Facilities Engineering Command, "Facility Certification Report: Drydock Number One, Boston Naval Shipyard, Boston National Historical Park, Charlestown, Massachusetts," September, 1984.

[93] These documents include the two engineering studies cited in footnote 2 and: U.S. Department of the Interior, National Park Service, "Charlestown Navy Yard: Boston National Historical Park: General Management Plan," volume II, December, 1980; Mary Jane Brady and Christopher J. Foster, Inc., "Historic Structure Report Dry Dock 1, Charlestown Navy Yard, Architectural Data" prepared for the Denver Service Center, National Park Service, U.S. Department of the Interior, 1979; Stephen P. Carlson, "Charlestown Navy Yard: Historic Resource Study," v. 3, (Division of Cultural Resources, Boston National Historical Park, National Park Service, 2007), pp. 152-171.

[94] "General Management Plan," v. II, p. 21.

Primary Features

Floor

The original granite floor and gutter, which extends down the center of the chamber, are primary features. The concrete floor at the seaward extension is also a primary feature. In general, the granite blocks of the dock floor are in good condition. There is no evidence of any substantial settlement or movement of the granite blocks, in either the original section of the chamber (where the blocks rest on a timber pile foundation), or at the head of dock (where the blocks rest on hard clay). Some repointing of the joints in the granite floor is recommended. In general, the cleaning of the masonry should not include the removal of paint, rust, or other elements that constitute the "patina" of the granite for this "patina" reflects the historic character of the dry dock's operations.

At the head of dock, the bottom three granite steps that arced around the dock's head were demolished and a concrete slab was poured on top of the granite floor. Although the date of this work is unknown, it occurred after 1946 and was probably part of the 1947-1948 seaward extension. In addition, the center gutter at the landward end of the dock floor is covered with concrete blocks that extend approximately 60 feet from the center slide toward the seaward end. The concrete slab and concrete blocks over the gutter are in fair condition with some cracking along the seam of the slab, as well as some cracking at the edges of the concrete blocks.

The floor at the seaward extension, specifically the reinforced concrete in the propeller pit, which was enlarged in the 1950s and again around 1961 to accommodate sonar domes, is seriously cracked and requires removal and replacement. Some of this cracking is tied to the drilling into the original concrete floor for the enlargement for sonar domes.

It is recommended that the propeller pit be restored to its 1947-48 configuration and that the deteriorated concrete be replaced. This work should include the rehabilitation and restoration of the granite flooring of the original turning gate, so that this historic feature can be interpreted.

Altars and Step-backs

The granite altars and step-backs are primary features, as are the replacement concrete altars that were installed during the 1947-1948 seaward extension. All of the walls are generally level and there is only minimal seepage through either the granite or concrete blocks. Virtually all of the granite blocks are in good to excellent condition; however, several have been damaged or cracked either from dry docking activities or from the drilling of holes to install iron or steel appurtenances. It is recommended that the damaged blocks be repaired with dutchmen or with selected replacement of matched granite.

All of the mortar joints should be fully cleared of vegetation and humus material. Also, the joints should be cleared of cracked or deteriorated mortar and debris such as silt or other accumulated inorganic material. An environmentally safe herbicide should be used in the removal of all vegetation. Finally, all of the granite should be repointed and grouted. Repairs and specifications for masonry work should be prepared in accordance with the Secretary of the Interior's *Standards for the Treatment of Historic Properties*.

Structural repair work to the chamber walls was carried out (in 1947-1948, along with the seaward extension) to arrest the outward bulging sections of original granite masonry. A large quantity of the granite blocks forming the altars on the east and west sides of the chamber, near the seaward extension, were removed and reinforced concrete was used in place of stone. Steel sheet piling was also installed around the perimeter of the dock.

Much of the concrete is severely deteriorated with extensive cracking or spalling. Efflorescence extends around many of the cracks. A number of the WR&A core samples indicated sound concrete; however, horizontal cores taken in sections of the concrete altars contained numerous fractures, indicating problems of "rotten" concrete, likely a result of saltwater intrusion into the concrete.

Extending along some sections of Altar No. 3 is timber blocking, much of it severely deteriorated. It appears this timber blocking has not been used since the war years of the 1940s. The timber blocking should be removed with care so that the altars are not damaged during their removal.

Stairs and Slides

There are three pairs of original stairs that serve the dry dock: Stairs 1 and 2 are located on the east and west walls at the seaward end of the original (granite-constructed) dock and extend down from the top to the lower broad altar. Stairs 3 and 4 are located on the east and west sides at the head of dock. Parallel to these two stairs are a pair of slides, composed of massive granite blocks, on both sides of each stair. These stairs and slides are primary features of Loammi Baldwin's original design and they continue to provide access to several altars all the way down to the dock floor.

Stairs 5 and 6 are located on the east and west sides of the chamber, in the middle sections of the original dock, and extend down only to the second broad altars. Each of these stairways is blocked off with timber decking (placed across the openings at level of the dock's coping), supported by heavy timber frames. This access down to the second broad altars has been blocked for several decades, and likely dates from the 1940s. All six stairways retain a high degree of integrity and are integral elements of the dry dock's operation from its inception.

Stairs 1 and 2

Stairs 1 and 2 were altered as part of the 1947-1948 Seaward Extension. The upper sections of the two stairways, which extend from the top of the dock down to the first broad altar (Altar No. 4), were completely reconstructed with concrete. The original granite stairs from the broad altars to the dock's floor were retained. In the late 1950s, however, the remaining section of original granite at Stair 1 was removed, as part of the construction of a large new culvert, which extended through the concrete wall. The lower part of Stair 1 was relocated several feet to the north and rebuilt with reinforced concrete. The U.S. Navy completed this work in 1960.

In 2004 the National Park Service oversaw the rehabilitation of Stairs 1 and 2 for compliance with code, thus permitting safe access to the dock's floor. Stair 1 on the east side of the chamber is constructed entirely of reinforced concrete and contains new pipe railings that are OSHA compliant. Stair 2 on the west side is of reinforced concrete from the coping level, down to the landing at the first broad altar (Altar No. 4). The section of the stairway that extends from the broad altar to the dock floor was rehabilitated with repairs to the original granite stairs that retained their historical integrity. Also installed at Stair 2 were new pipe railings that are OSHA compliant. Both Stairs 1 and 2 are in excellent condition and do not require any treatment.

Stairs 3 and 4

These stairs are of identical granite construction and are significant components of Baldwin's original design at the head of dock. The adjacent granite slides are in good condition and as are the stairs, with the exception of several stair blocks which have chipped edges. In addition, one step that has been replaced with concrete and a number of granite blocks at the bottom of each stair have moved. Steel stanchions with iron fittings and chain railings are in very poor condition at both stairs.

It is recommended that the bottom blocks of each stair be reset to uniform treads and risers (compatible with the original design) and that the single concrete step be replaced with granite. Also, the chipped stair blocks should be repaired with dutchmen from similar Quincy granite.

All of the stairs and slides should be repointed and grouted consistent with the Secretary of the Interior's *Standards for the Treatment of Historic Properties*. The steel stanchion and chain railings should be replaced with new OSHA compliant steel hand railings, similar to those recently installed at Stairs 1 and 2. No steel security gates are necessary at these highly visible and exposed stairs at the head of dock.

Stairs 5 and 6

These two stairways remain at their original location but were completely reconstructed during the repair of the chamber's walls as part of the dock's seaward extension in 1947-1948. The original granite stairs were removed and the new stairways were constructed of reinforced concrete. They have been closed for many years and the openings at the coping level have been covered over with timber decking. This was likely done to permit additional work areas at the coping of the dock.

These stairs are primary features of the dock and the alterations that were carried out to them are evidence of the Navy's operations of Dry Dock 1 over the course of its history. However, if the reopening of Stairs 5 and 6 at the coping level does not interfere with the repair of vessels it is recommended that the stairs be reopened and repairs made to the concrete. This work should be carried out in concert with the recommendations to repair Stairs 3 and 4. If the Stairs 5 and 6 are to remain closed the timber supports to the timber decking should be rehabilitated and the timber decking should be replaced.

Coping

The 19th-century granite coping is in fair to good condition, although some of the granite paving is chipped at the edges and the mortar joints have experienced cracking as well as chipping. There is no significant upward movement or settlement of the copingstones, a testament to the sound construction and substructure.

Similarly a concrete slab, which extends beyond the granite coping and which was installed as part of the seaward extension in the late 1940s, is in fair condition, but is cracked or chipped. Both the granite and concrete coping are significant elements associated with the dry dock's historic appearance. Mortar joints and expansion joints should be carefully inspected and repaired for the continued durability of the copingstones and concrete slab.

Care should be taken in the repair of the supports for the safety fencing, the posts of which are bolted into the coping. In addition, regular maintenance should be performed to the joints between the copingstones to keep it free of vegetation. As noted earlier, an environmentally safe herbicide should be used to keep the dry dock clear of vegetation.

Head of Dock

To accommodate longer ships the head of dock was dramatically altered in 1941 by the removal of the granite center slide and the later cutting and removal of adjacent altars and step-backs. This part of the head of dock should be rehabilitated to its original appearance to restore one of the key features of Loammi Baldwin's original dry dock design. This recommended rehabilitation work includes the restoration of the bottom three granite stairs, around the arced head of dock, as well as the adjacent altars. Also, the missing granite block, which was located at the fourth step at the center slide, should be restored. Most importantly, consideration should be given to replacing the center slide to restore the original appearance of the dock. In lieu of this major restoration project, at the very least, the concrete and brick that cover the granite stone backing should be removed and the granite stone backing should be restored.

Cleaning and repair is needed of the coping and two stones on both sides of the center slide that contain the inscriptions that commemorate the dock's construction and the nationally prominent individuals associated with the dock. Part of the inscription indicating the date of completion has spalled off and should be carefully patched. The inscription has also been obliterated by heavy rust marks from the steel frames of electrical panels on the coping. These granite blocks are the only granite blocks in the entire dry dock that should be cleaned in a non-abrasive manner so that the historic inscription is restored. In addition, the steel frames of the electrical panels should be replaced with a material that will eliminate future rusting at this location.

All of this stonework should be repointed and grouted in accordance with the Secretary of the Interior's *Standards for the Treatment of Historic Properties*.

Steel Caisson

Fabricated at the Charlestown Navy Yard in 1901, the steel caisson is one of the dry dock's most significant 20th century structures. Although the records for repair work on the caisson are not complete, the structure has been overhauled on several occasions. This work has included some welding of steel plate, strengthening riveted connections with welded connections, and the replacement of the gasket around its perimeter. A new timber deck was installed in 1984. The most recent overhaul occurred in 1991.

As indicated previously, the Navy's engineering consultant recommended a thorough overhaul of the caisson, including its dry-docking followed by an intensive inspection of all structural members, connections, and steel plating. The consultant also recommended non-destructive testing of the steel, with the use of a portable spectrograph.[95]

[95] WR&A Report, pp. 26-28.

In addition to this inspection work, it is recommended that a thorough investigation of documentation be performed, encompassing a search for drawings, specifications, and other documents relating to the caisson, including its original design and fabrication, through its various overhauls and repairs. This added documentation will not only aid in the structural investigation prior to the redesign of deficient structural elements, but will also aid in the rehabilitation of the caisson in a manner that is sensitive to its historic integrity.

1947-1948 Concrete Seaward Extension

The Seaward Extension in 1947-1948 significantly altered Dry Dock 1. As noted above a large number of granite altars and step-backs were removed on either side of the chamber and replaced with reinforced concrete. At the seaward end, the U.S. Navy's contractor constructed reinforced concrete walls, although parts of the granite walls at the base of the turning basin were retained and incorporated into the new concrete work.

Over the years these walls have experienced extensive cracking and spalling of concrete. Some of the cracks have been patched, but cracking has continued and extensive amounts of efflorescence are evident around many of the cracks.

Although the walls appear to be structurally stable, they are in need of patching and grouting. Areas of spalled concrete need to be examined for further deterioration. Rotten concrete needs to be removed and replaced with new concrete.

1960 Dewatering Tunnel Intake

While the tunnel intake no longer functions as part of the dewatering operation of the dry dock, it is a significant feature both visually and historically, and it is tied to the final years of the Navy's active use of the facility. The steel frame extending across the entrance to the intake is rusted and in a deteriorated condition. It should be repaired and rehabilitated, and if structural steel sections are compromised, new steel members, compatible with the 1960 construction, should be installed.

Additional Features

Crane Tracks

The 20-foot gauge crane tracks that extend around Dry Dock 1 at the coping level are composed of rolled steel rails and contribute to the understanding of hauling equipment in the repair of vessels. The tracks are in poor condition and in need of repair or stabilization. It is recommended that the crane tracks be preserved as part of the larger rehabilitation work carried out around the coping level of the dock.

Safety Fencing Surrounding the Dry Dock

The steel stanchion with iron fittings and chain railing is an important visual feature of Dry Dock 1. Sections of this fencing are no longer in place and a number of stanchions are missing or seriously deteriorated. It is recommended that this historic fencing be repaired and missing sections be sensitively replaced.

The NPS needs to decide on its long-term needs for the replacement of the existing public safety fencing/guardrail that was installed after the dry dock's period of historical significance. Although the railing of this fencing/guardrail, constructed of recycled material, is in fair condition, it is visually incompatible with the other historic features located at the coping level. Most seriously, many of the wood posts supporting the railing are in poor condition and in need of replacement. It is recommended that a less visually intrusive, more transparent design be developed for this safety fencing/guardrail not only for upgrading to building code requirements, but also to be architecturally harmonious with the other historic elements of the dry dock and this area of the Navy Yard. At the head of dock, the security fence/guardrail is located within a few feet of the tops of Stair 3 and Stair 4. This provides excellent views of the dry dock chamber for park visitors but insufficient access to the stairs and around the head of dock at the coping level. The new security fence/guardrail should be designed so that it can be moved an additional ten feet away from the head of dock during ship repair operations to afford workers sufficient access to the stairs and working area around the head of dock. The security fence/guardrail could then be moved back to its present location when the dock is not in use.

Capstans, Bollards, Bitts, Cleats, and Rings

The five capstans that served the dry dock are no longer operable, but are significant features tied to the history of the dock's operation.

Electric-powered Capstans. The three electric-powered capstans should be restored to operable condition prior to the next use of the dock. Capstan 1 is at the west side of the seaward entrance; Capstan 2 is at the head of dock; and Capstan 3 is at the east side of the seaward entrance. Among the serious deficiencies are the corroded steel cover plates covering the concrete capstan pits of Capstans 1 and 3. Moreover some of the reinforced concrete that forms the walls of the pits has deteriorated and is in need of patching. A thorough inspection of the mechanical and electric equipment of the driving mechanisms should be carried out and new gearing, motors, and electrical lines be replaced as warranted.

Capstans 1 and 3 were enclosed in early 1950s wooden sheds with slightly sloped roofs, hinged doors and sliding side panels that were opened for operation. Several years ago the shed for Capstan 1 collapsed during a storm and was removed. The shed for Capstan 3 is in dilapidated condition and should be removed along with the obsolete electrical equipment and utility boxes. New sheds similar to the 1950s wood sheds should be replaced for these two capstans with durable, consistent materials to accommodate the new electrical equipment.

Capstan 2 at head of dock had a gambrel style removable wooden shed until the late 1970s and is now open to the weather. Because of its strategic and highly visible location for park visitors at the head of dock, it is recommended that a new removable, gambrel wooden shed be designed to maintain maximum visibility of the dry dock from the head of dock.

Hand-operated Capstans. There are two hand-operated ratcheting capstans at each side of the original dock entrance. These two capstans were originally used to operate the mitered timber turning gates and possibly to maneuver the original floating timber caisson. They are important features that are integral to the operation and interpretation of Baldwin's original dry dock. These two capstans are in fair condition. They should be inspected and any interior deterioration should be stabilized and the capstans repainted.

Bollards, Bitts and Cleats. The dry dock contains a total of 12 bollards—six extending along either side of the dock at the coping level. The bollards appear to be in fair condition, although they should be inspected to ensure that they are structurally sound. Similarly, the bolts or fasteners that secure the bollards to the stone or concrete coping should be inspected for signs of structural distress and replaced where required with historically compatible bolts. The bitts located on the caisson are in good condition, as are each of the pair of cleats on the east and west side, near the seaward end.

Iron Rings. The dry dock contains nearly 100 iron rings that are located either within the dock's chamber or at the coping level. Nearly all of these rings have experienced high levels of corrosion and many are unusable. About 10 percent are severely rusted and likely in need of replacement. Because these rings contribute significantly to the dock's historic character, they should be repaired, where corrosion has not fully compromised the structural integrity of the ring or its iron spike that attaches the ring to the granite masonry. Where corrosion is advanced to the point that the ring needs to be replaced, a new historically compatible ring should installed in place of the older, deteriorated ring.

Keel Blocks

Of the 98 keel blocks, of reinforced concrete construction, approximately 15 are suffering from cracking or spalling of concrete. The concrete of the remaining keel blocks, however, is in fair to good condition. Virtually all of the timber members resting on top of the keel blocks are rotten and in need of replacement. Moreover, many of the steel U-bolts embedded in the concrete and used to lift the keel blocks into position are entirely corroded and completely unusable. The NPS should assess its long-term needs for numbers and sizes of blocks that will be required for active dry-dock service and carry out the required repair to the keel blocks and the steel U-bolts.

Along with the removal of unusable keel blocks, a non-historic structural column—in the form of a fluted concrete pedestal—which formerly supported a viewing stand, should be removed. This element is incompatible with the historic character of Dry Dock 1.

Keelson and Plinth

Along the centerline of the granite dock floor at the head of dock is a series of concrete blocks, seven feet wide at the head, and tapering to six feet in width, extend a length of approximately 60 feet. These concrete blocks constitute the remnants of a ca. 1930s keelson. It is recommended that these concrete members be removed as part of the restoration of the dock's granite floor and its center granite gutter at the head of dock.

A ca. 1960 concrete plinth is located along the centerline of the granite floor at the seaward end of the original dock and between Stairs 1 and 2. It is also recommended that this concrete plinth be removed and the original granite floor and the center granite gutter be restored.

The execution of these two proposals along with the removal of the concrete slab over the floor at the head of dock will result in the restoration of the overall granite floor to its 1860 appearance.

Draft Gauges

The eight draft gauges that remain at various locations in the dry dock are important contributing elements in the interpretation of the dock's operation. The two gauges of wood are deteriorated and in need of replacement. At the head of the dock, the gauges are painted on the stone. Most of the numbers of the gauge on the east side of the dock's head are worn away and barely visible. Sensitive restoration of both gauges at the head of the dock is recommended.

Two additional gauges, one of wood and one painted on the chamber walls near the propeller pit, are similarly deteriorated and in need of restoration. Finally, a pair of gauges, composed of brass numbers and embedded in the concrete walls of the seaward extension, are in deteriorated condition with the brass heavily oxidized. It is recommended that these two gauges be cleaned and restored to original (1940s) condition.

Steel Platforms

The two large steel platforms on the east side of the dry dock and the large steel platform on the dock's west side are rusted and in need of repair. While the rusting exhibited among the steel sections of the frames supporting the steel grates appears to be superficial, severe corrosion has occurred in the steel struts supporting the platforms, most noticeably in the supports for the platform near the seaward end on the dock's east side. A thorough structural inspection of the platforms, including a close examination of the steel members and connections, is recommended and redesign should be carried out in accordance with the original materials and appearance of these work platforms.

The two smaller viewing platforms, located on the east side of the dock, appear to be in fair condition; however, these platforms should be similarly inspected. They are not as significant to the dock's history as the work platforms and if the structural assessment calls for their removal, replacing these viewing platforms is not recommended.

Utilities

The utilities that served the dock date largely from the 20th century and include numerous pipes, cables, wires, utility boxes, and support members that carry the lines the length of the dock. Many of these lines are no longer operational and a number of cables, pipes, and supporting members are in very poor condition. Where required the utilities that pose a hazard because of their poor condition should be removed and replacement is not recommended. For the steel frames and utility boxes at the head of dock, an alternative design for a less intrusive structure should be developed. Furthermore these structures should be moved as they currently occupy one of the more prominent locations at the head of dock.

Lighting

The 27 contemporary 400-watt floodlights provide lighting of the dry dock chamber. If the NPS provides additional lighting around the perimeter of the dock, solar-powered fixtures consistent with NPS environmental policies, should be utilized.

B. Requirements for Treatment

Public Safety
It is important to separate the two types of users present at the site: Specifically, workers performing repairs to naval vessels, and the general viewing public at Dry Dock 1.

Workers should be provided life safety protection as regulated through the Occupational Safety & Health Administration (OSHA). Of particular concern for this site is the issue of fall protection. Worker fall protection should be provided via guardrails, as directed by OSHA's Standard 1926.502, "Fall Protection Systems Criteria and Practices."

Compliance with the broad array of OSHA requirements needs to be the responsibility of the contractor performing work on a vessel in the Dry Dock. Temporary guards will need to be erected around the Dry Dock since the historic posts and chains do not comply with OSHA standards. Additional guards and other temporary safety precautions will need to be erected. The design of these measures needs to be specifically designed to facilitate the particular construction work.

The general NPS policy of trying to comply with state and local building codes should be adhered to. The existing gray synthetic wood fence/guardrail around the Dry Dock is not visually compatible with the historic and visual character of the Dry Dock. This guardrail should be replaced with an appropriate steel guardrail complying with the state building code. Selected viewing areas should be incorporated into this design. When the Dry Dock is actively used, this guardrail and a signage system must also conform with OSHA's pedestrian consideration under paragraph 6D, "Pedestrian and Worker Safety", of OSHA 1926.202 – Signs, Signals and Barricades.

The park's interpretive plans call for limited public access into the Dry Dock. Railings and guards for this activity are governed by the state building code. Temporary barriers need to be added to the current OSHA-based railing system. These barriers should be differentiated from the historic replacement rail system and be removable so as not to detract from the historic and industrial character of the Dry Dock.

Fire Protection
While there is very little combustible construction components in the dry dock, fire protection issues are still a significant concern especially when USS *Constitution* and USS *Cassin Young* are docked and under repair. The layout of any constructed elements at the site should, however, be reviewed by the Boston Fire Department to confirm that established fire lanes for the Park are maintained and that the Fire Department agrees that adequate emergency access for firefighting apparatus and personnel be maintained.

When the USS *Constitution* is berthed at Pier 1, its sprinkler system is connected to a fire main, which is located above grade and travels a horseshoe-shaped configuration along he face of the pier and west side of the Dry Dock. When the USS *Constitution* enters the dry dock, it should be reconnected to this system and if needed, additional temporary measures added.

Accessibility

Accessibility to those areas designated as open to the visiting public in a National Park Service facility are required to be in compliance with the Americans with Disabilities Act (ADA).[96] Specific attention will be required in providing an accessible route to areas open to the visiting public. More specifically, issues of pedestrian walkway surface treatment, slopes and cross-slopes will need to be addressed. Any site features such as drains, thresholds, etc. will be required to be designed as barrier-free to the physically challenged.

Public visitor access for individuals with mobility impairments cannot be provided into the lower levels of the dry dock as it is presently configured. Access to the dock's floor via removable ramps is impractical and would also adversely impact the character defining features of the dock. Without elevator access, which would have to be removable when the dock is in operation and would be impossible to implement, there is no way to provide equal access to all. Alternative programmatic access could be provided by using interactive panels that feature floor level photographs or a live audio/video feed from a tour guide. These panels should be strategically placed at the coping level.

Hazardous Materials

Asbestos. On November 23, 2003, Axiom Partners, Inc. of Wakefield, MA prepare a hazardous material report which is included in the WR&A Dry Dock No. 1 Study, Condition Assessment Report dated February 27, 2004. Small quantities of asbestos were identified in asphalt roofing debris and roofing material on a small electrical shed at the Caisson end of the Dry Dock. It appears that both of these areas have been abated.

Lead-based Paint. Included in the above report was a testing of 12 paint coatings, of which 8 were found to contain detectable levels of lead. Lead-based paint does not need to be abated, however, if lead-based paint surfaces are impacted by restoration or renovation work, this work is governed by OSHA and EPA regulations. OSHA requirements govern worker safety and EPA requirements govern waste disposal.

[96] While the ADA technically does not apply to federal facilities, NPS Director's Order 42 specifies that ADA guidelines will be used in current construction and alteration projects unless the Uniform Federal Accessibility Standards, issued under the Architectural Barriers Act of 1968, provides a higher degree of accessibility.

C. Recommended Implementation Strategy

Introduction

In "Section A: Ultimate Treatment and Use," appropriate preservation treatments were recommended for the character-defining features of the dry dock. In addition to these recommendations, the timely treatment and sequencing of the rehabilitation and restoration work need to be identified for the proper programming of funding, as well as for the requirements for using the dry dock in the near future for the safe docking of USS *Constitution* and USS *Cassin Young*. The NPS prepared a PMIS to rehabilitate Dry Dock 1 in 1998, revised cost estimates in 2003 and updated the document in November 2006.[97]

During the preparation of this report, it was determined that USS *Cassin Young* must be dry docked in late 2008 for extensive hull examination and repairs, all of which will require several months of docking.[98] Additionally, USS *Constitution* is scheduled for dry-docking in 2012 for a major overhaul that will extend to 2014. Accordingly, this recommended strategy for implementation comprises a logical phasing of rehabilitation treatments, while permitting the safe docking of the two historic vessels over the next several years. At the same time, this recommended strategy highlights the necessary rehabilitation activities that will prevent serious additional deterioration of the dry dock's character defining features.

The resulting strategy for implementation is divided into three major phases: The first is the immediate repair work that should be undertaken before the scheduled docking of USS *Cassin Young* in late 2008. The second or intermediate phase is the three-year period between completion of the dry-docking of USS *Cassin Young* in 2009 and the dry-docking of USS *Constitution* in 2012. The third phase is the long-term repair work that will be undertaken within five years after the docking of USS *Constitution* is completed in 2014. Importantly, expensive repairs that can await the second and third phase will enable proper budgeting procedures to be more readily achieved over a longer period of time.

Phase I. Immediate Repairs (Before Dry Docking of USS *Cassin Young* in 2008)

1. <u>Conduct Detailed Inspection and Repair of Steel Caisson and Install Cathodic Protection with Monitoring System.</u>

One of the highest priorities in the repair of Dry Dock 1 concerns the Steel Caisson, now in a closed position. The dry dock is not operable without a fully functioning caisson and, given its current unknown condition, its potential for structural failure, however minimal it may be, must be addressed. A detailed inspection of this structure has not been performed in more than a decade so that only a limited assessment of the caisson's condition is possible at this time. It is therefore recommended, as stated in the WR&A Report and PMIS 16306, that the Steel Caisson be dry-docked and a complete inspection, testing, and evaluation of this structure be carried

[97] See PMIS 16378 (BOST-C-211.000) – Rehabilitate Dry Dock 1 as updated November 3, 2006 by the Boston National Historical Park.

[98] See PMIS 16306 (BOST-C-234.002) as recently updated on May 17, 2007 by the Boston National Historical Park for repairs to the USS *Cassin Young* and the Steel Caisson of the dry dock.

out. All of the ensuing repairs that are required to the structural steel members, riveted connections, and replacement of deteriorated sections of the hull plate should be performed in a manner compatible with the historic integrity of caisson's original appearance and configuration. In addition to other key repairs—including the replacement of caisson seals, repair of valves, and the rehabilitation of the electrical system—a cathodic protection and monitoring system, as proposed by WR&A, should be installed for the long-term performance and operation of the caisson. The current estimated cost of dry-docking the Steel Caisson, inspection and repairs to the caisson are contained in PMIS 16306 and are estimated at approximately $600,000.[99]

2. <u>Retain Structural Hangers and Utility Supports on Side Walls but Remove Obsolete and Non-Historic Utility Lines</u>.
Utility lines extend along the east and west sides of Dry Dock 1. The most extensive lines, however, are located along the east wall. Here, above Altar #1, are approximately 80 steel hangars that support a deteriorated utility cable. It is recommended that all utility lines, including cables, pipes, and wires, which date from the post 1960 years and are no longer operable or needed, be removed and that new lines be installed in a manner that is sensitive to the historic operation of the dock. The structural supports and hangars, which date from the pre-1960 years, should be retained, as they are a small but contributing part of the dry dock's historic integrity.

3. <u>Repair, Repoint, and Grout Granite Stairs and Install New Stair Railings at Head of Dock.</u>
The granite stone work of the two stairs at the head of dock is in good condition with the exception of some minor cracking, stone movement at the base of both stairs, and one step that has been replaced with concrete. The mortar throughout, however, is badly deteriorated or altogether missing. All joints need to be cleaned and full-depth joint repair and repointing is required. The stairs that exhibit movement should be reset and the concrete step should be replaced with granite to match the original stairs. In addition, installation of new stair railings that meet code and are sensitive to the historic character of the dry dock are recommended. These railings should be designed and fabricated similar to the new railings recently installed for the stairways at the seaward end of the dock.

4. <u>Repair and Restore Steel Stanchion and Chain Fencing on Coping around Perimeter of Dock.</u>
The historic steel stanchion and chain fencing is a contributing historic feature of the dry dock. A number of the stanchions are out of plumb or deteriorated, and several are missing, most notably along the north side, near the head of dock. The rusted posts need to be scraped and painted, those that are bent or seriously deteriorated need replacing, and missing posts should be reinstalled. The chains are generally in good condition though some sections are deteriorated or missing, especially along the north side of the dock. The overall steel stanchion and chain fencing should be upgraded for long term performance.

[99] Ibid.

5. Repair and Stabilize Steel Platforms and Gratings.
The three large steel platforms, all constructed in the late 1940s or early 1950s, are deteriorated and in need of repair. Most critical are the struts that support the platforms. Fabricated of steel angle sections, these struts have experienced severe corrosion and loss of section. Other steel members are rusted, as are the steel grates, but this deterioration is largely superficial. Areas of corrosion and loss of section should be repaired or replaced in kind. The grates and all steel structural members should be cleaned and treated with an anti-corrosion coating.

6. Repair or replace requisite number of Keel Blocks to permit docking of USS *Constitution* and USS *Cassin Young*.
Approximately 98 keel blocks and bilge blocks are in various stages of deterioration with most of their wooden dunnage missing or in poor condition. It is recommended that the NPS determine the number and type required to dock the two ships and repair or replace the required number of blocks at this time. Current estimated cost of repairing or replacing the necessary keel blocks and lay them out for dry-docking of USS *Cassin Young* are estimated in PMIS 16306 at approximately $110,000.[100]

7. Remove All Deteriorated Wood Altar Fenders.
All remaining 20th century wood altar fenders on the third altar below the coping of both side walls are in advanced stages of deterioration, including the steel attachments into the granite and concrete altars. The wood fenders should be removed to eliminate a safety hazard and the corroded steel attachments should be removed three inches below the altars and the holes plugged with matching mortar.

[100] Ibid.

8. Restore Electric Capstans to Operating Condition with Housing.
Restore the three power capstans and their electrical equipment to operating condition to assist in the dry docking, evaluation and repair of the steel caisson and to assist in the dry docking of USS *Cassin Young* and USS *Constitution*. The U.S. Navy recently determined that these three capstans are necessary for the dry-docking of the two ships. The steel plates covering the electrical equipment at the two seaward capstans should also be replaced. The wood housing that covered the two seaward entrance capstans should be replaced to protect the equipment. The capstan at the head of dock had a gambrel-shaped covering that was removable during operations. It is recommended a new removable wood housing be designed as low as possible to minimize the visual obstruction at this strategic visitor location at the head of dock. The proposed work and cost estimate of $272,000 are contained in PMIS 75135.[101]

9. Remove and Arrest all Vegetation from Joints and Treat to Prevent Reoccurrence.
This will ensure safety for workers utilizing the altars and floor of the dry dock during docking of USS *Cassin Young* in late 2008 and prepare the dry dock for granite and concrete repairs to the chamber walls, altars, coping and head of dock during Phase II.

[101] See PMIS 75135 as recently updated on February 5, 2007 by the Boston National Historical Park.

Phase II. Intermediate Repairs (Between Completion of Dry-docking of USS *Cassin Young* in 2009 and Dry-docking of USS *Constitution* in 2012)

1. Repair Concrete Walls in Deteriorated Areas
Over the years, small-scale concrete patching projects have been performed to arrest the numerous cracks in the concrete walls, floors, step backs and altars. The results of these efforts have varied from fair to poor. While there is no danger of structural failure in the near future and the dock can function without any serious known problems, it is recommended that a comprehensive repair effort be undertaken for all of the deteriorated concrete work. This will entail thorough inspection, testing, and evaluation of the concrete to determine the best method for repairing the cracked or deteriorated concrete.

In addition, testing to determine the condition of the reinforcing steel in the walls, floors, and altars is recommended. If large amounts of corrosion are found, a more extensive rehabilitation project will be required for the long-term structural integrity of the dry dock. Overall, this work may require a series of phases for carrying out the inspection, design, and construction. Budgeting for the various phases of the work should be planned for a multi-year effort.

2. Repair, Repoint and Grout Granite Walls, Coping and Altars and Head of Dock
The granite stonework is in good to excellent condition and the walls do not exhibit signs of any appreciable movement since the dry dock's chamber was last renovated in the late 1940s. Accordingly, the structural integrity of the walls will not be compromised by the use of the dry dock in the near future. For the intermediate-term, however, it is recommended that a comprehensive rehabilitation project be executed encompassing the repair of cracked granite masonry and the repointing and grouting of the walls, coping, and altars. This work should be coordinated with the repair of the concrete walls in a multi-year effort.

3. Repair and Restore Draft Gauges and Painted Markers.
Undertake and coordinate this repair and restoration activity as a component of the masonry work to repair the concrete walls and repair, repoint and grout the granite walls and altars. Brass markers should be salvaged and reused wherever possible.

4. Repair or Stabilize Iron Bollards, Bitts, Cleats and Rings.
Also undertake and coordinate this repair and stabilization work as a component of the repairs, repointing and grouting of the granite walls and head of dock altars, since most of the work involves the restoration or replacement of iron cleats and rings that are attached to the historic granite masonry.

5. Redesign and Install Compatible Public Safety Fencing/ Guardrail Around Dock.
The redesign and installation of a new safety fence/guardrail around the perimeter of the dock should be scheduled near the end of Phase II so that the overall appearance of the dry dock will be substantially enhanced for the dry-docking of USS *Constitution* in 2012.

Phase III. Long Term Repairs (After USS *Constitution* Leaves Dry Dock in 2014)

1. Remove Concrete Floor to Restore Granite Floor at Head of Dock.

The removal of the deteriorated concrete floor will expose the granite floor near the head of dock and will enhance the overall appearance of the granite head of dock as designed by Baldwin.

2. Restore Center Slide and Three Bottom Steps of the Arc of the Head of Dock.

The restoration of the center slide and the three bottom granite steps around the arc at the base of the head of dock will restore the only element of the dry dock that has lost integrity. These two elements were integral features of Baldwin's original design at the head of dock and should be replaced to enhance the overall integrity of Dry Dock 1.

3. Restore Concrete Configuration of Flooring of Propeller Pit and Granite Flooring of Original Turning Gates.

The restoration of the configuration and integrity of the propeller pit and also the granite flooring of the original turning gates will interpret the end of Baldwin's original construction and the integration of the 1947-1948 seaward extension while restoring the integrity of the damaged features.

4. Repair and Stabilize Hand-Operated Capstans.

This work will preserve these early operational features of the original dry dock.

Appendix A | Bibliography

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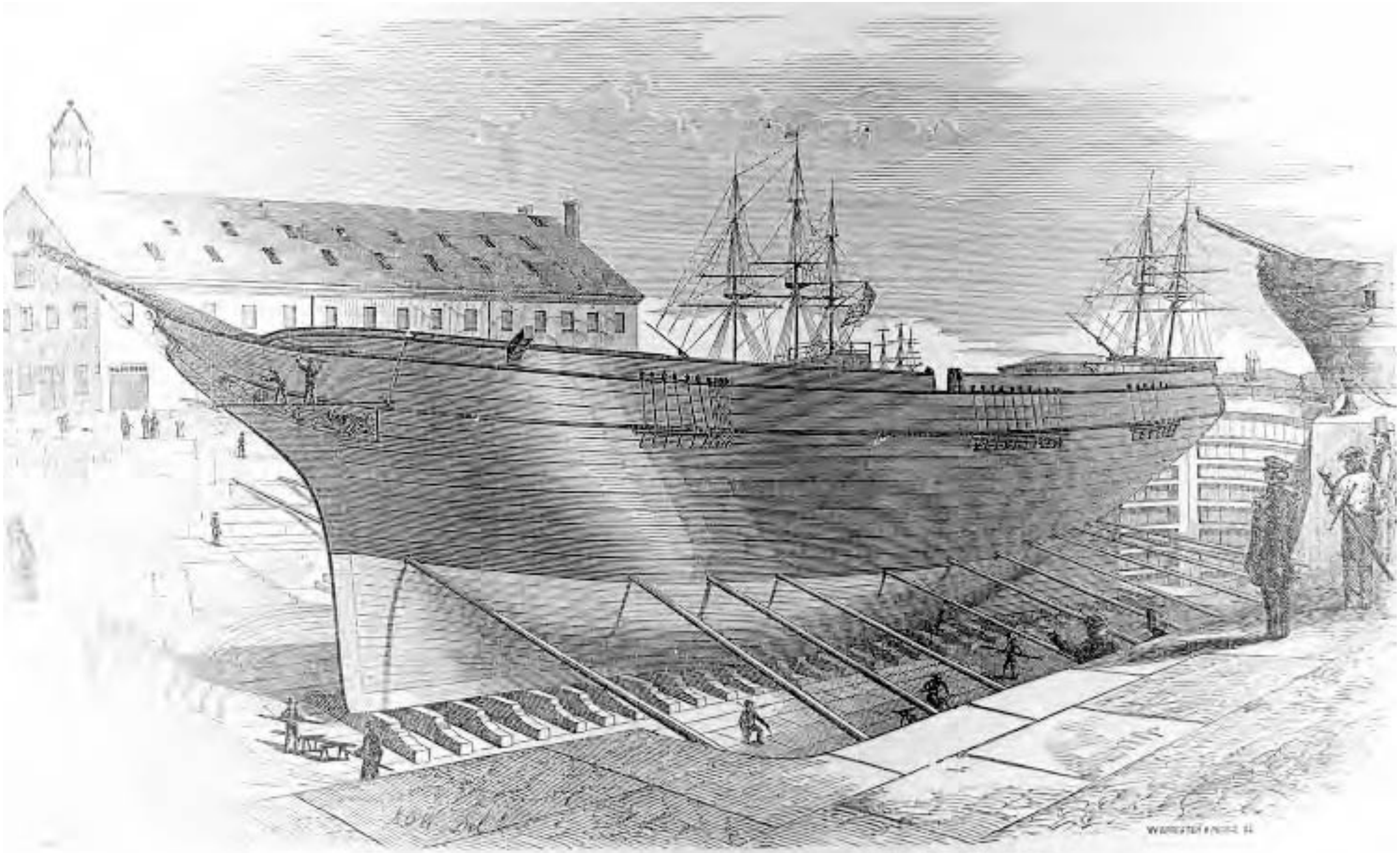
Appendix B | Historic Photographs



VIEW OF THE NAVAL DRY DOCK, AT THE U. S. NAVY YARD, CHARLESTOWN, MASS.

Fig. B-1 Engraving BOSTS – 8787. View looking south across the Drydock at the U.S. Navy Yard, Charlestown, Mass." Taken from Gleason's Pictorial Drawing Room Companion, vol. I. No. 7, June 14, 1851. Note keel blocks and wooden miter gates closing seaward end of dock.

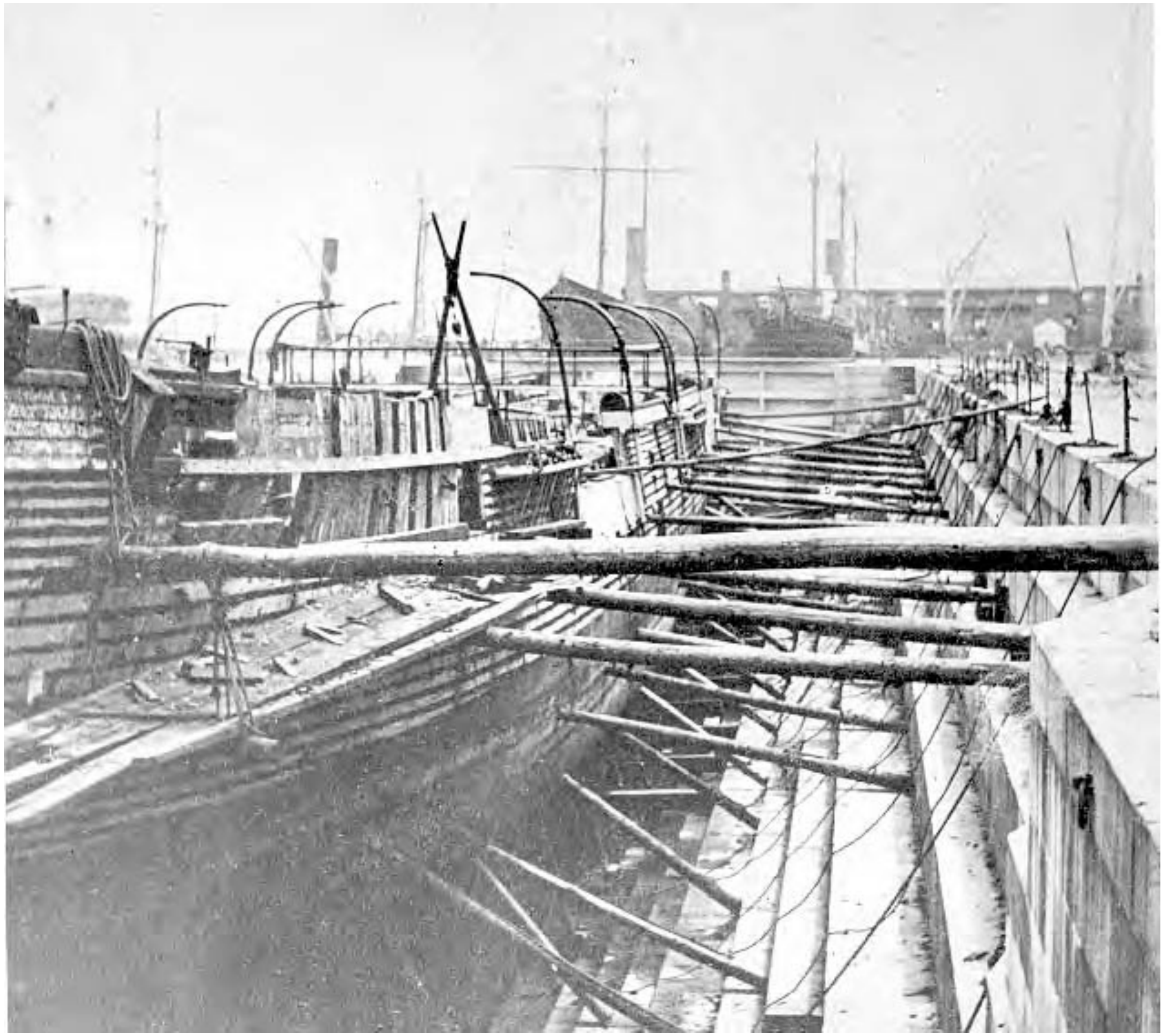


Fig. B-2 Photo BOSTS – 8788. View looking south of vessel undergoing repair at Dry Dock 1 in 1854. Note original iron stanchion and chain fencing on coping level to the right.

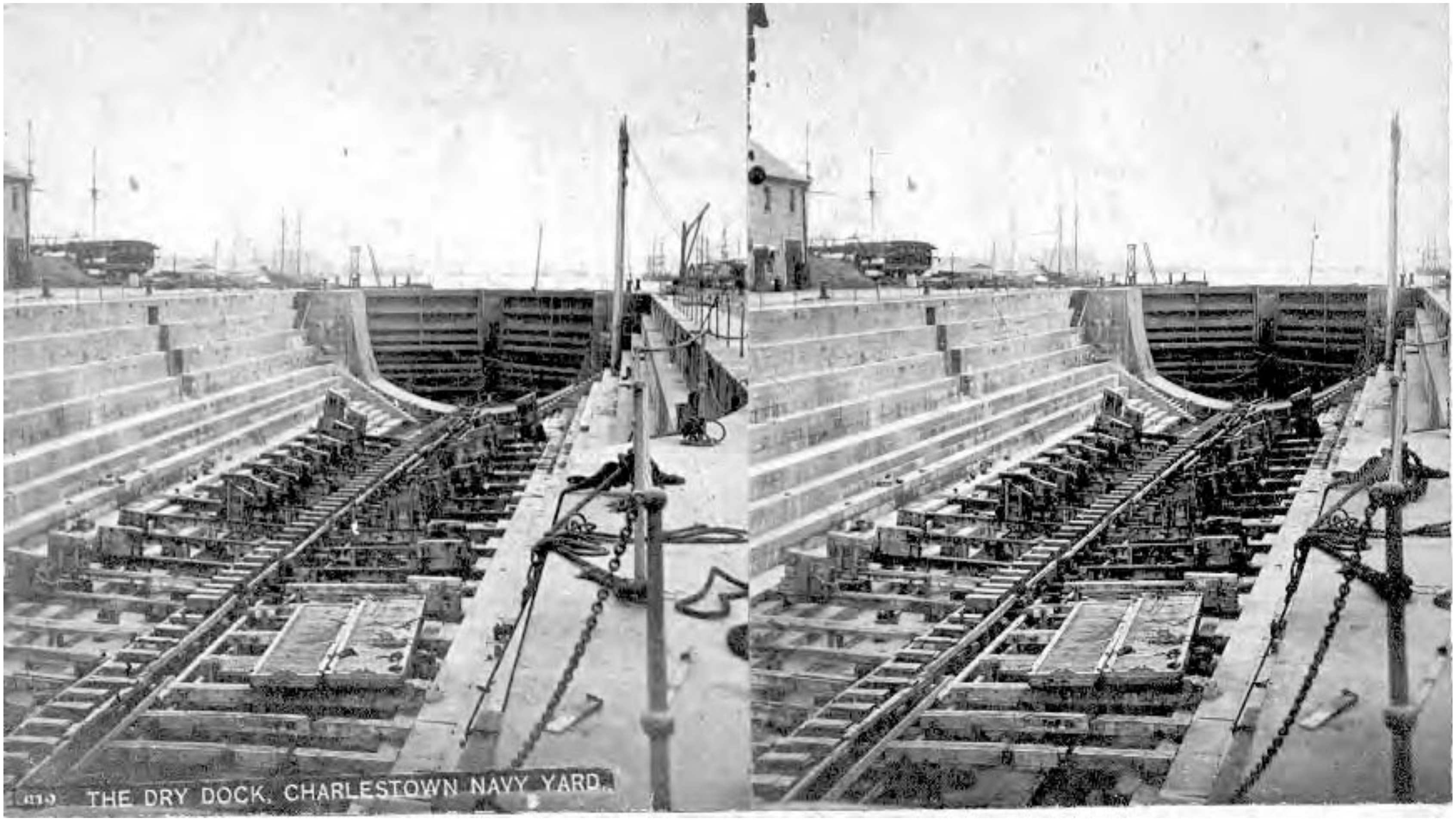


Fig. B-3 Stereoscopic Photo BOSTS – 8789, c1862-c1872. View of Dry Dock 1, looking southeast from the coping level near the head of the dock. Note detail of the metal stanchions and chain railing that extends around the perimeter of the dock. The timber turning gates are seen at the seaward end.

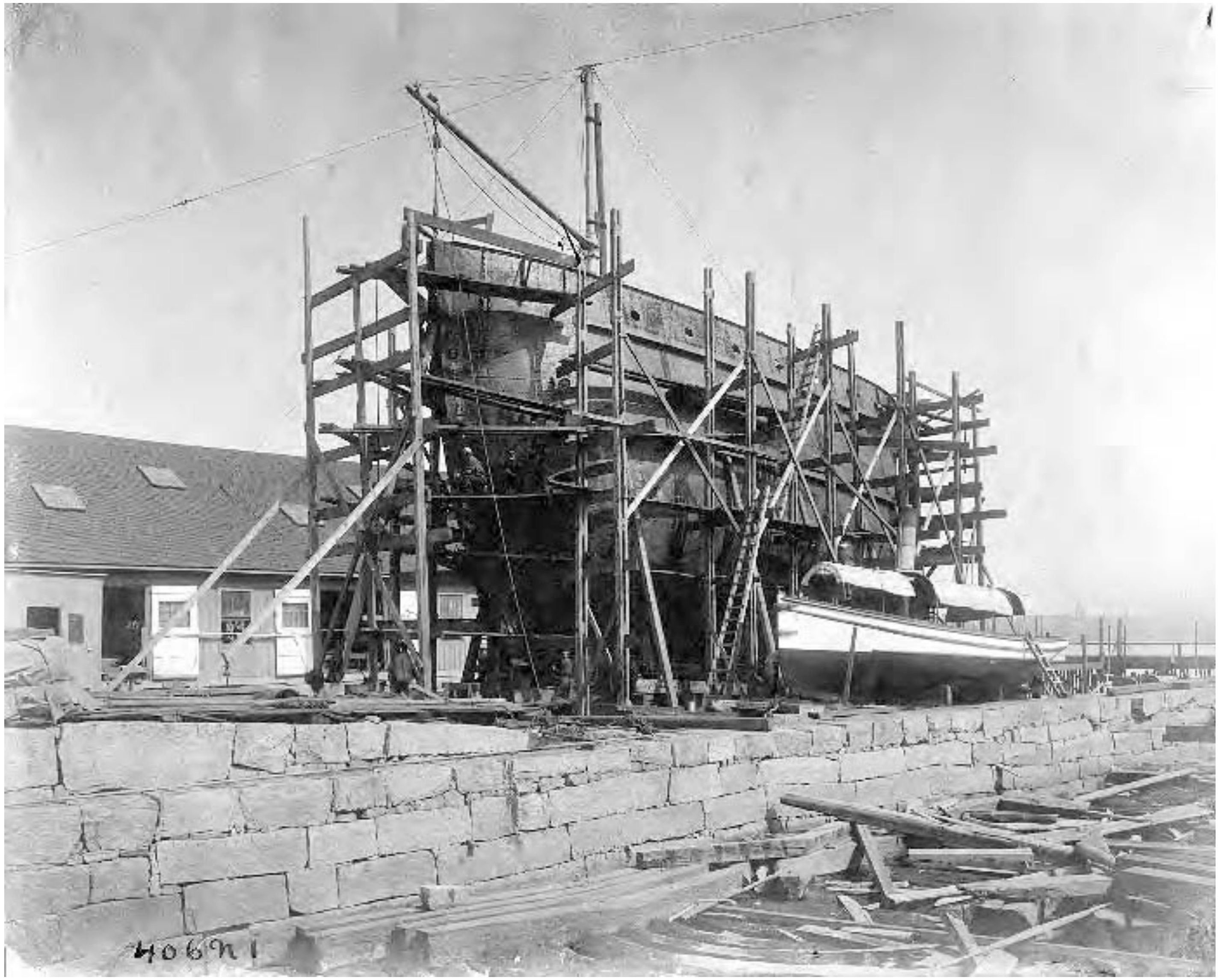


Fig. B-4 Photo BOSTS – 8803. A late summer 1901 construction view of the new steel Caisson nearing completion on the yard's Building Slip, formerly Shiphouse No. 39 (Building 73).

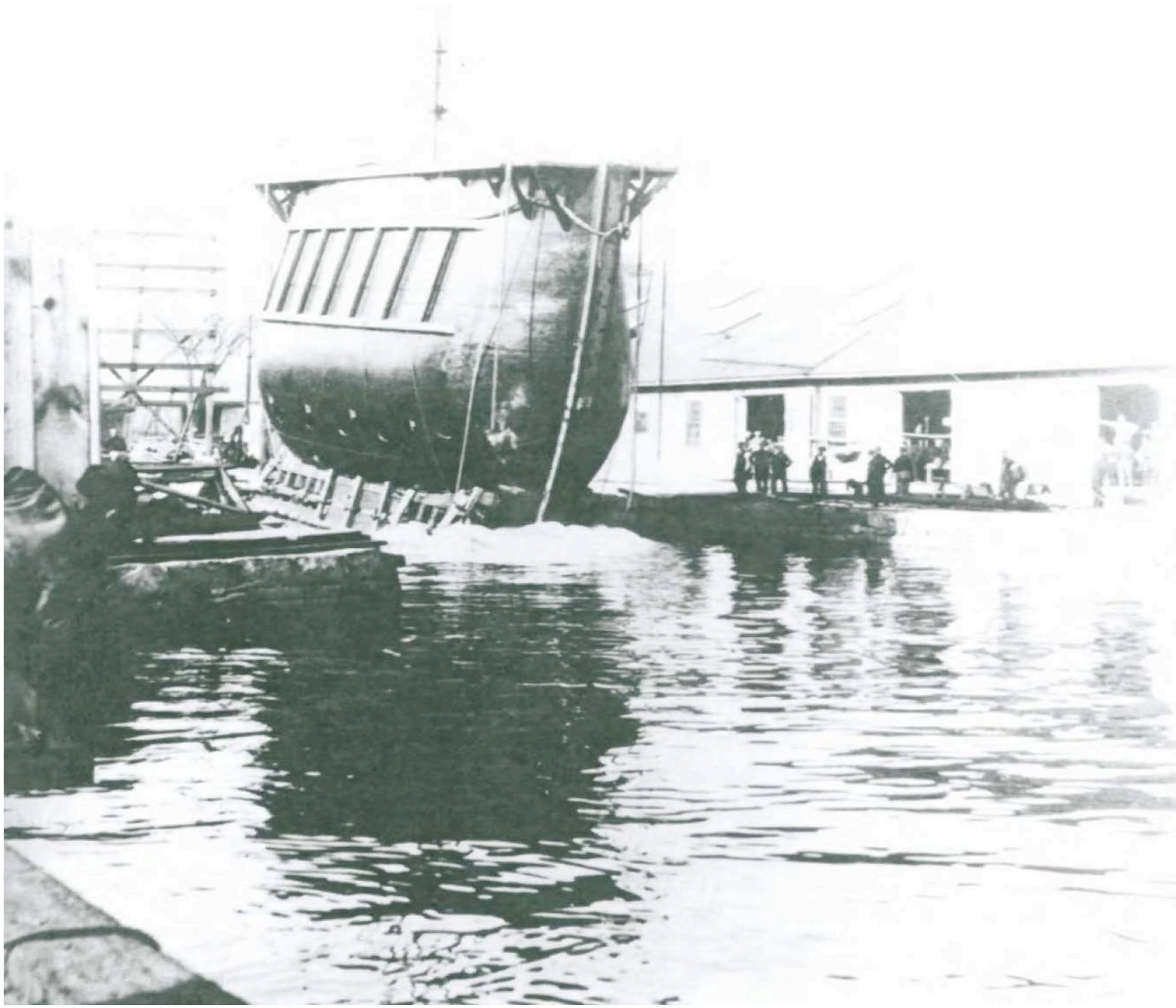


Fig. B-5 Photo BOSTS – 8803 shows launching of the new steel Caisson sliding down the ways of the Building Slip on October 31, 1901.

Fig. B-6 Photo BOSTS - 8791, June 9, 1913. Day laborers at work on the crane tracks on the east side of the dock. Note the stairway at the center of the dock that leads to the broad altar below. This access to the stairway is now blocked off.

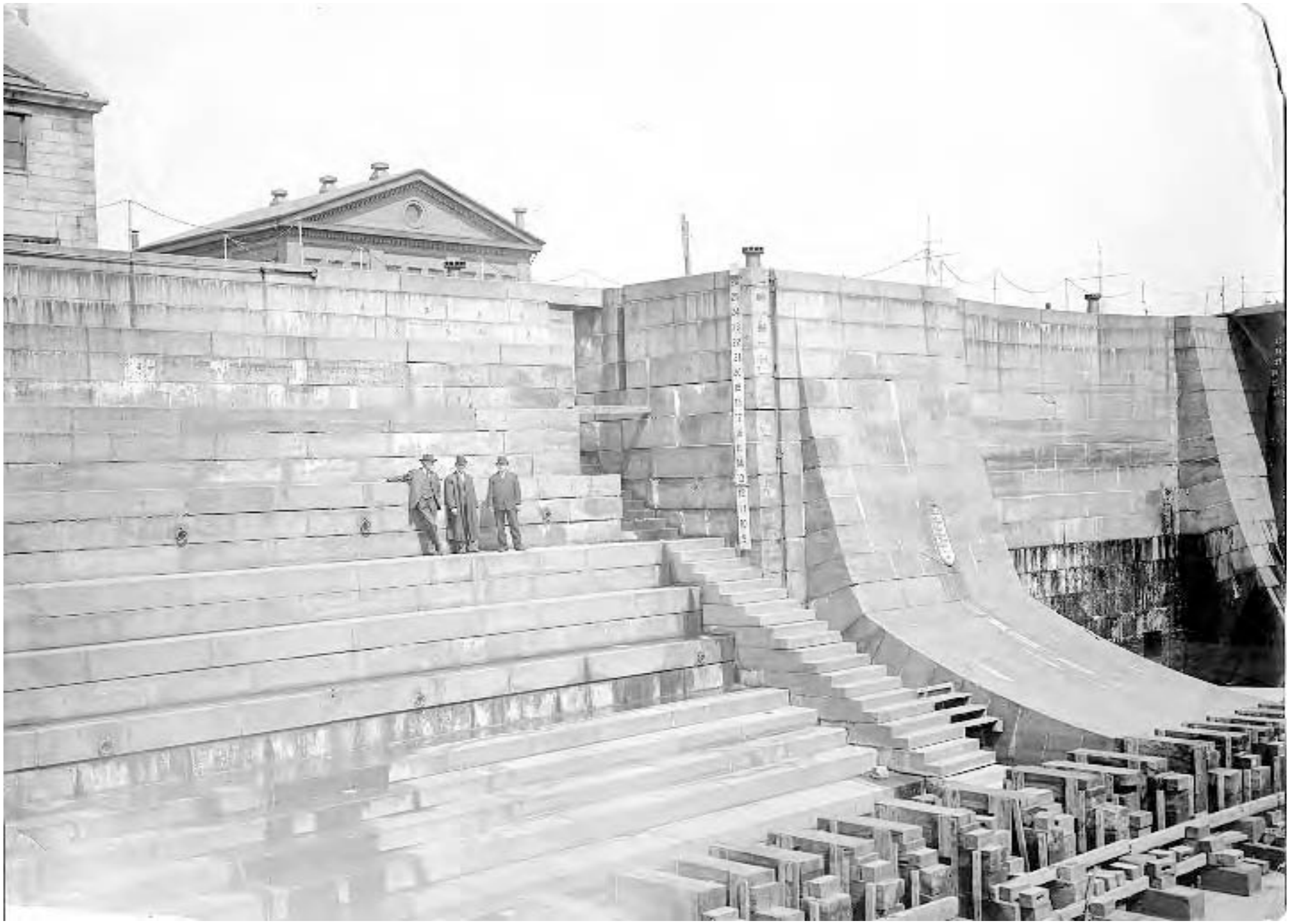


Fig. B-7 Photo BOSTS – 8790, c1900-c1920. View of east wall at the seaward end of the dock, after the installation of the steel caisson. The stone stairs at the center were removed in 1961, with the construction of a new tunnel intake. The draft gauge above the stairs has also been removed while many of the rings along the altars remain in place.

Fig. B-8 Photo BOSTS – 8790, c1900-c1920. View of the head of Dry Dock 1, looking northwest. The center slide and adjacent altars are intact, as are the curved granite stairs that lead to the dock's floor.

Fig. B-9 Photo BOSTS – 8790, c1910-c1920. View of the head of Dry Dock 1, looking northeast. Note that the original iron stanchion and chain fencing is around the perimeter of the dock but there is no fencing on the stairs.

Fig. B-10 Photo BOSTS – 8793. View of Dry Dock I, from 1930, looking northwest, toward the head of dock, with the turning basin in the foreground. Note that at the middle of the dock, on the west side, a wooden stairway was located above the lower altars and provided access to the dock's floor. Note also that a concrete keelson is being constructed on he granite floor near the head of dock.

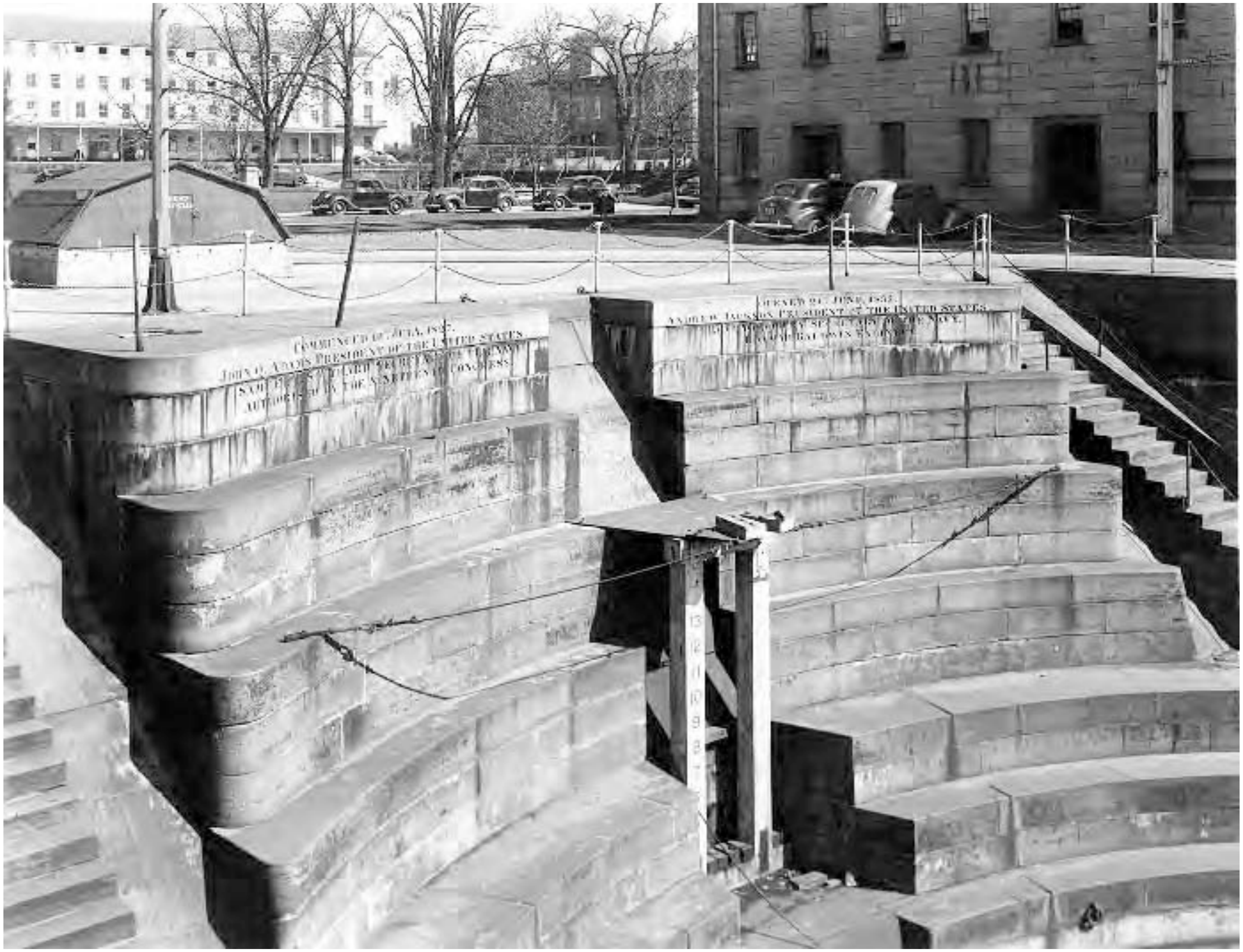


Fig. B-11 Photo BOSTS – 8792. View in 1939 looking northeast at head of dock. At the top, flanking the center slide, is the original inscription in the granite, acknowledging the originators and builders of the dry dock.

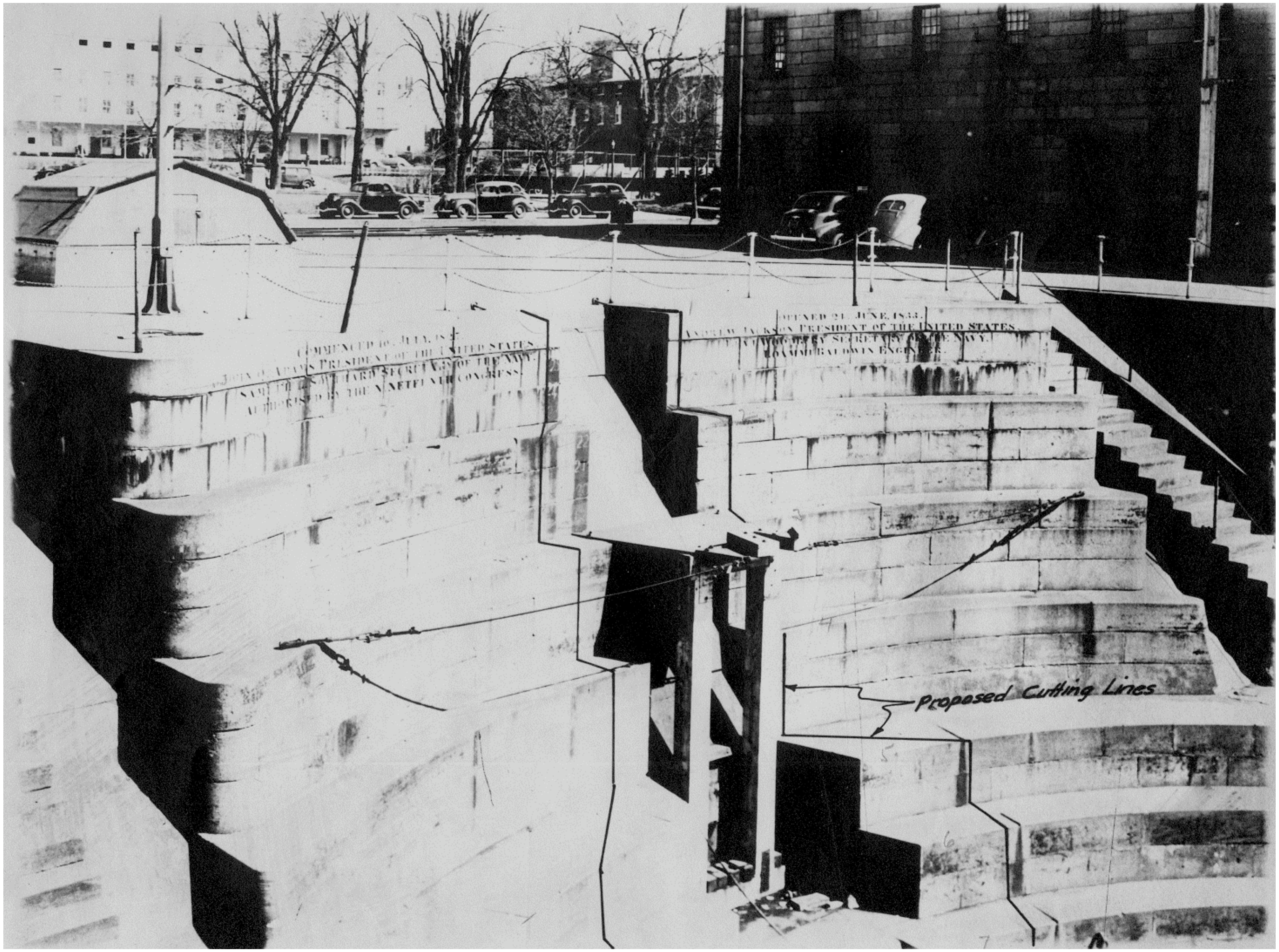


Fig. B-12 Photo BOSTS – 8792-1. Same 1939 photograph as Fig. B-11 with superimposed "Proposed Cutting Lines" to alter and enlarge the center slide. No date of superimposed overlay.

Fig. B-13 Photo BOSTS – 8795. View of the head of dock, looking northeast, on August 26, 1946. Note the altered center slide, which entailed the removal of the slide's massive granite blocks, carried out about five years earlier. Note that the granite backing, which was behind the center slide, is now visible. Most of this granite backing was later covered with concrete. Note the wooden platform, above the granite stairway. This platform was replaced with a steel platform in the mid-1950s. Also note that the curved granite steps at the floor level are still in place.

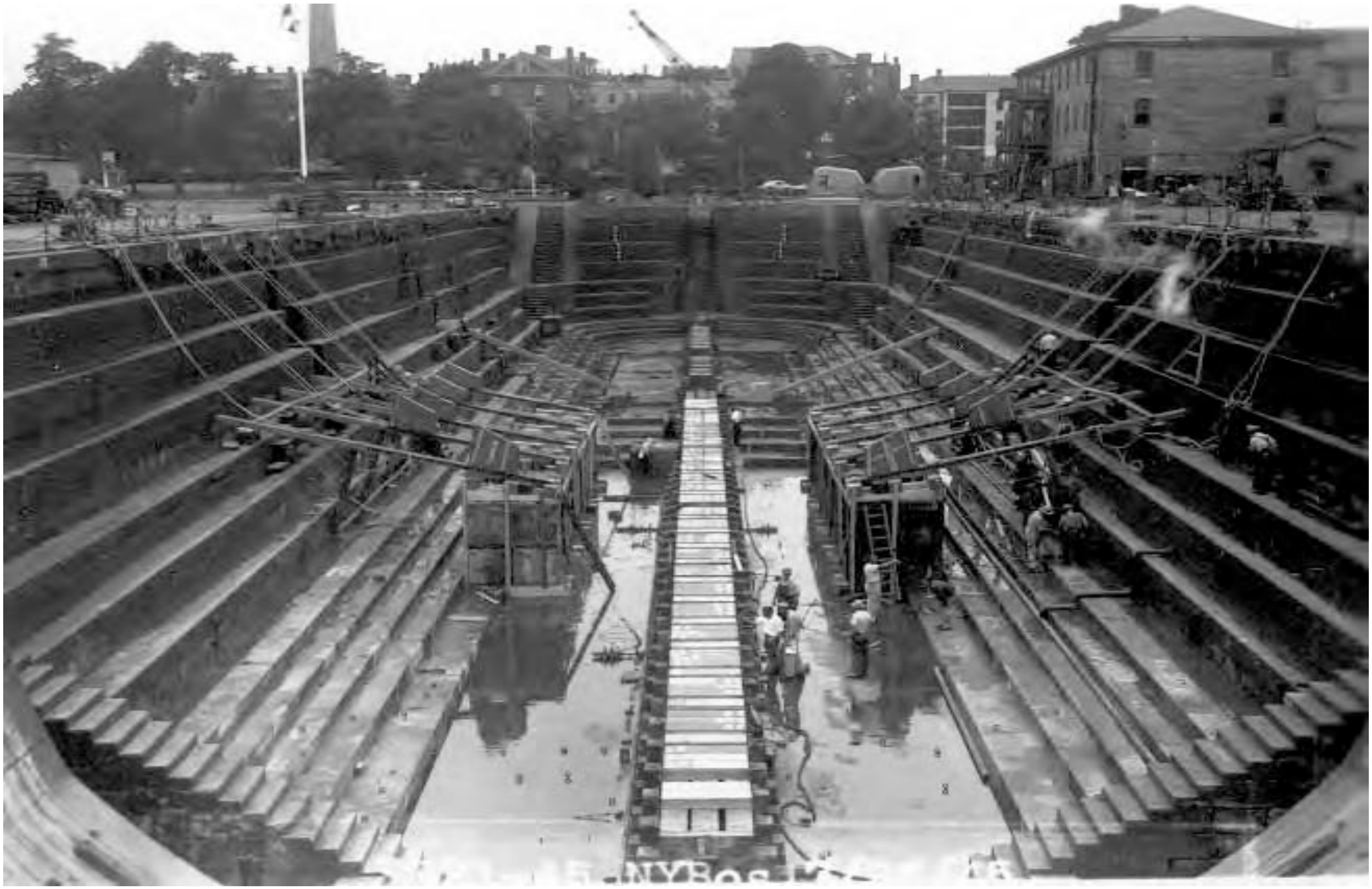


Fig. B-14 Photo BOSTS – 8794. July 1946 view of workers preparing for the removal of the original granite blocks, on both sides of the chamber. Reinforced concrete replaced the granite blocks. This work was carried out as part of the seaward extension in 1947-1948.

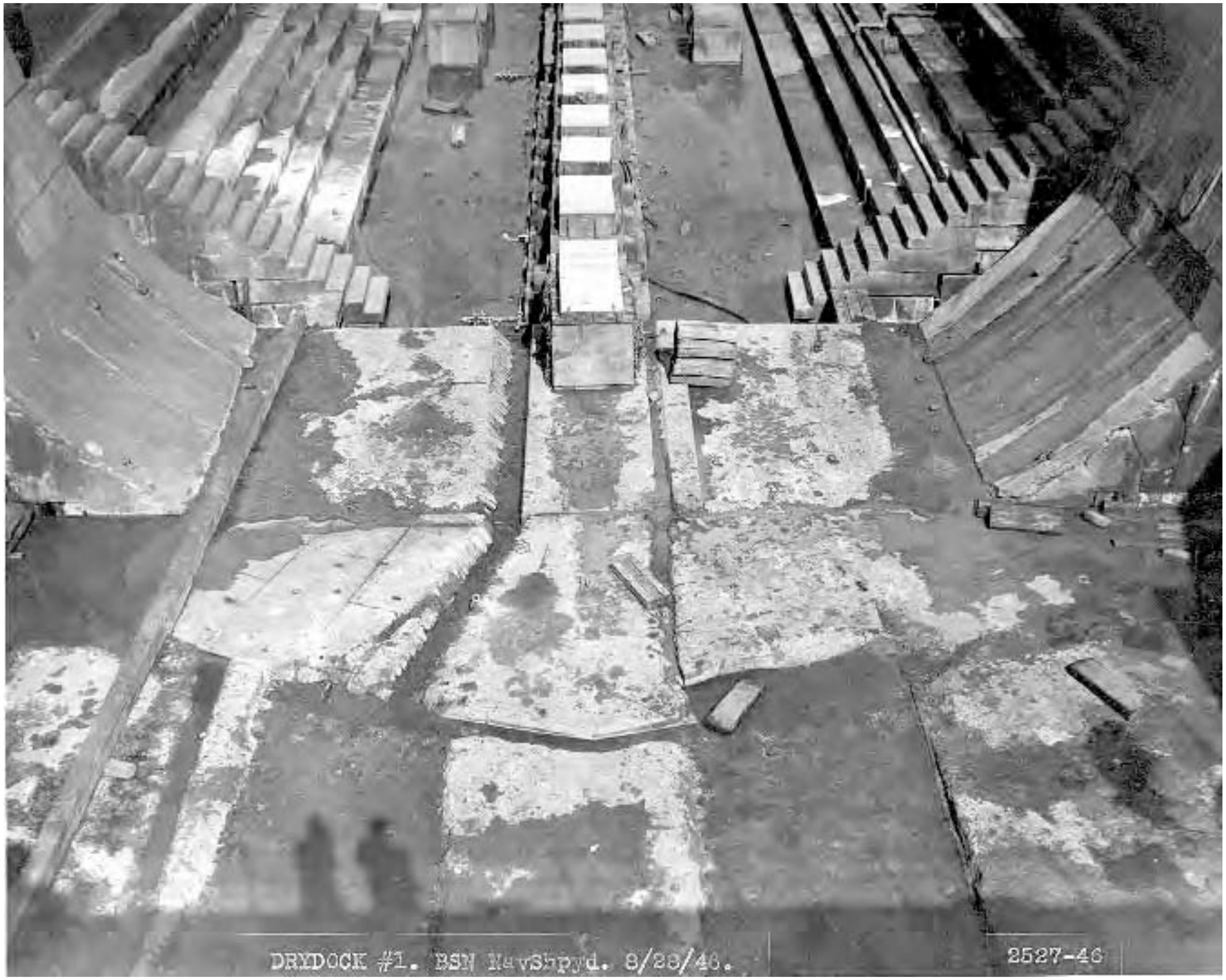


Fig. B-15 Photo BOSTS – 8795. August 26. 1946 view looking north of the floor at the seaward end of the dock, prior to its demolition as part of the seaward extension in 1947-1948.

Fig. B-16 Photo BOSTS – 8795. August 20, 1946 view looking northwest of the seaward side of the steel Caisson. Note the original granite seawall, which was demolished with the dock's seaward extension in 1947-1948.

Fig. B-17 Photo BOSTS – 8796. December 2, 1947 view looking west at cofferdams needed to support construction of the seaward extension. Cofferdam in the foreground and that on the far opposite contain concrete vaults to house the dock's electric capstans.

Fig. B-18 Photos BOSTS – 8796. February 3, 1948 view looking north during the reconstruction of a large section of the original granite chamber. This reconstruction work was carried out as part of the seaward extension and entailed the installation of steel sheet piling, a reinforced concrete backing (in place of the original rubble masonry backing), and reinforced concrete walls (in place of the original granite blocks).

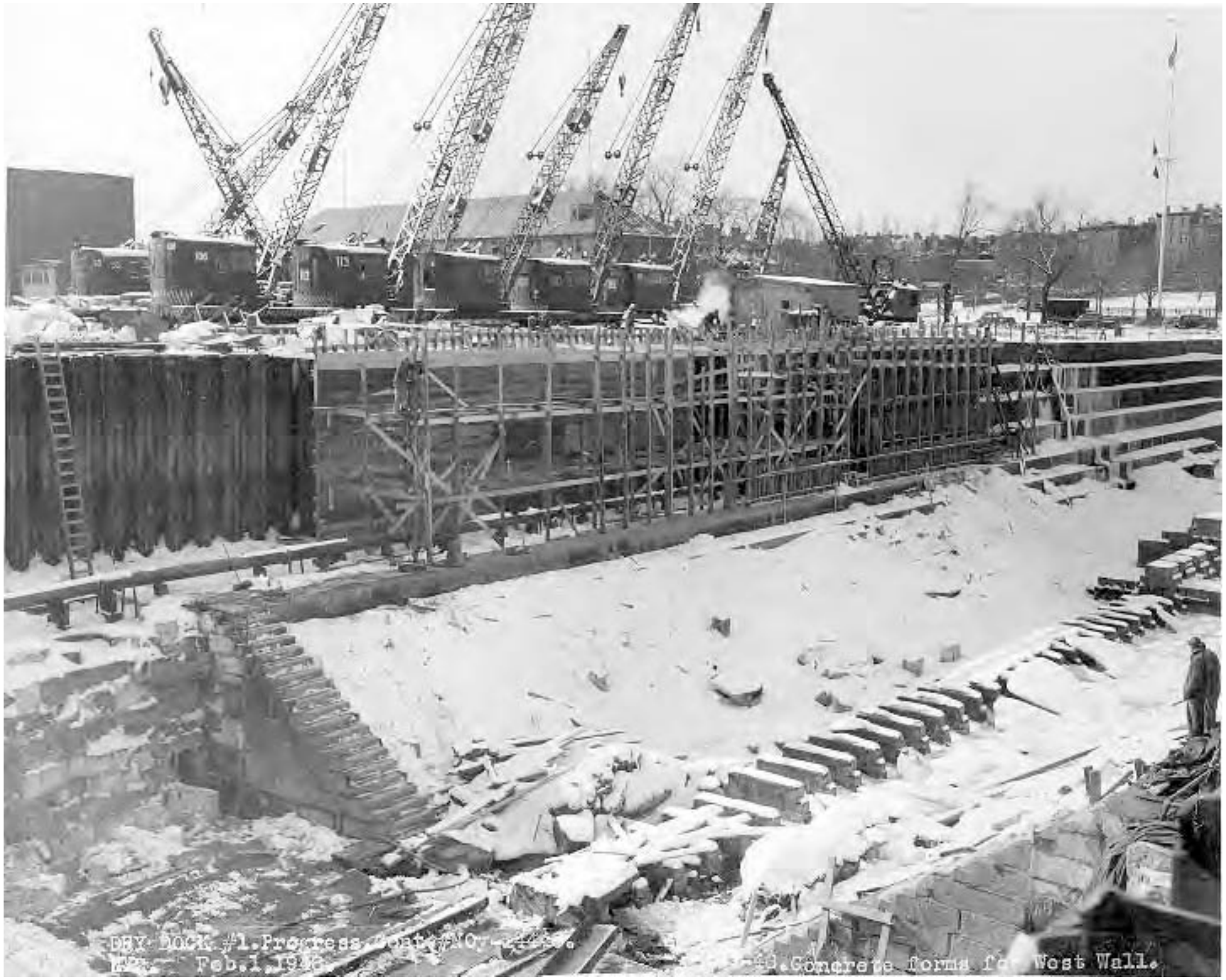


Fig. B-19 Photo BOSTS – 8796. February 1, 1948 view looking northwest of the reconstruction of the west wall. The granite blocks, below altar #4 (covered with debris and snow in this image), were retained, while reinforced concrete was used in reconstructing the walls above altar #4.

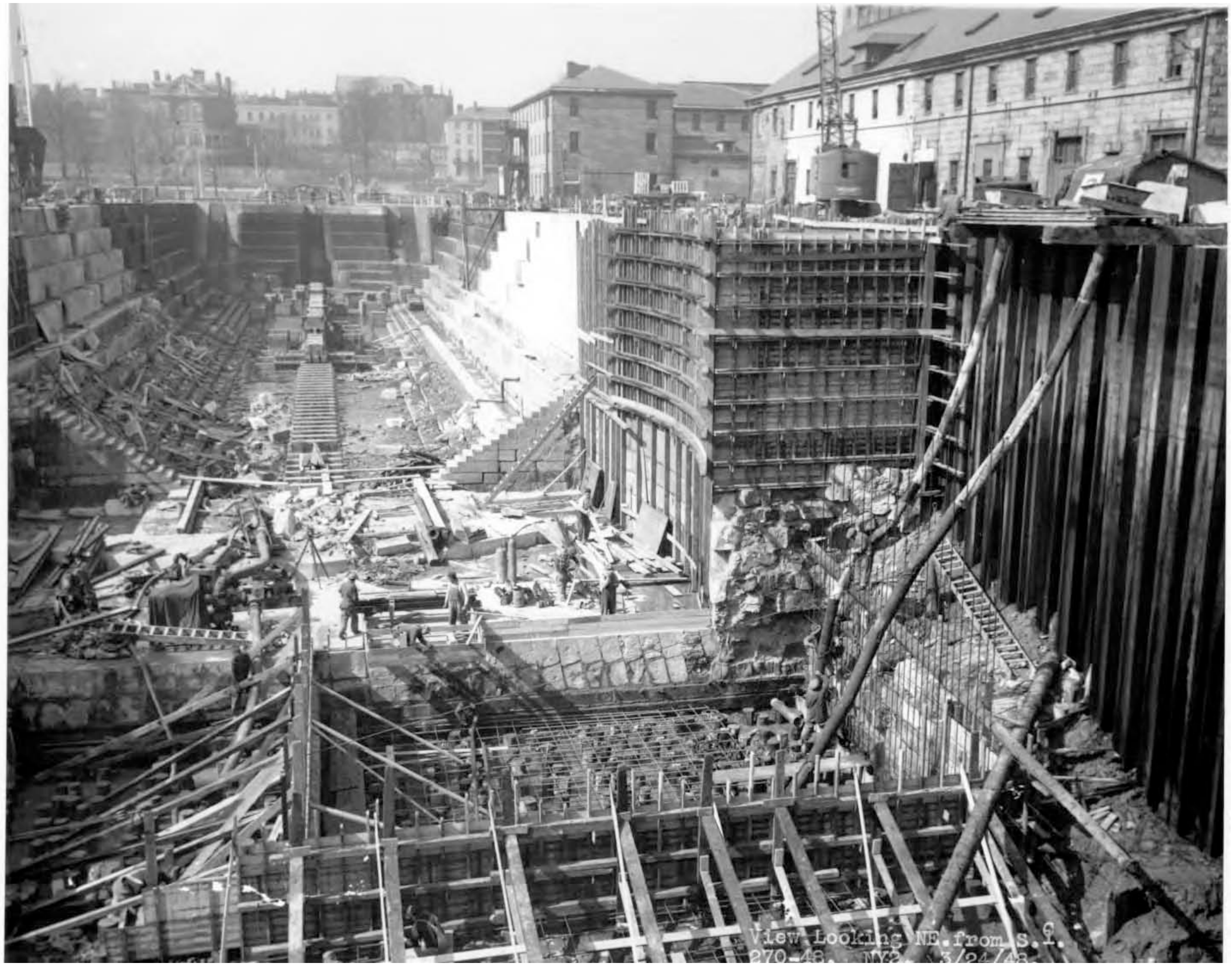


Fig. B-20 Photo BOSTS – 8796. March 24, 1948 view looking north showing the construction of the seaward extension. In the foreground is form work and reinforcing steel for the floor and propeller pit. Visible beyond are the recently completed reinforced concrete walls and altars that replaced the original granite masonry.

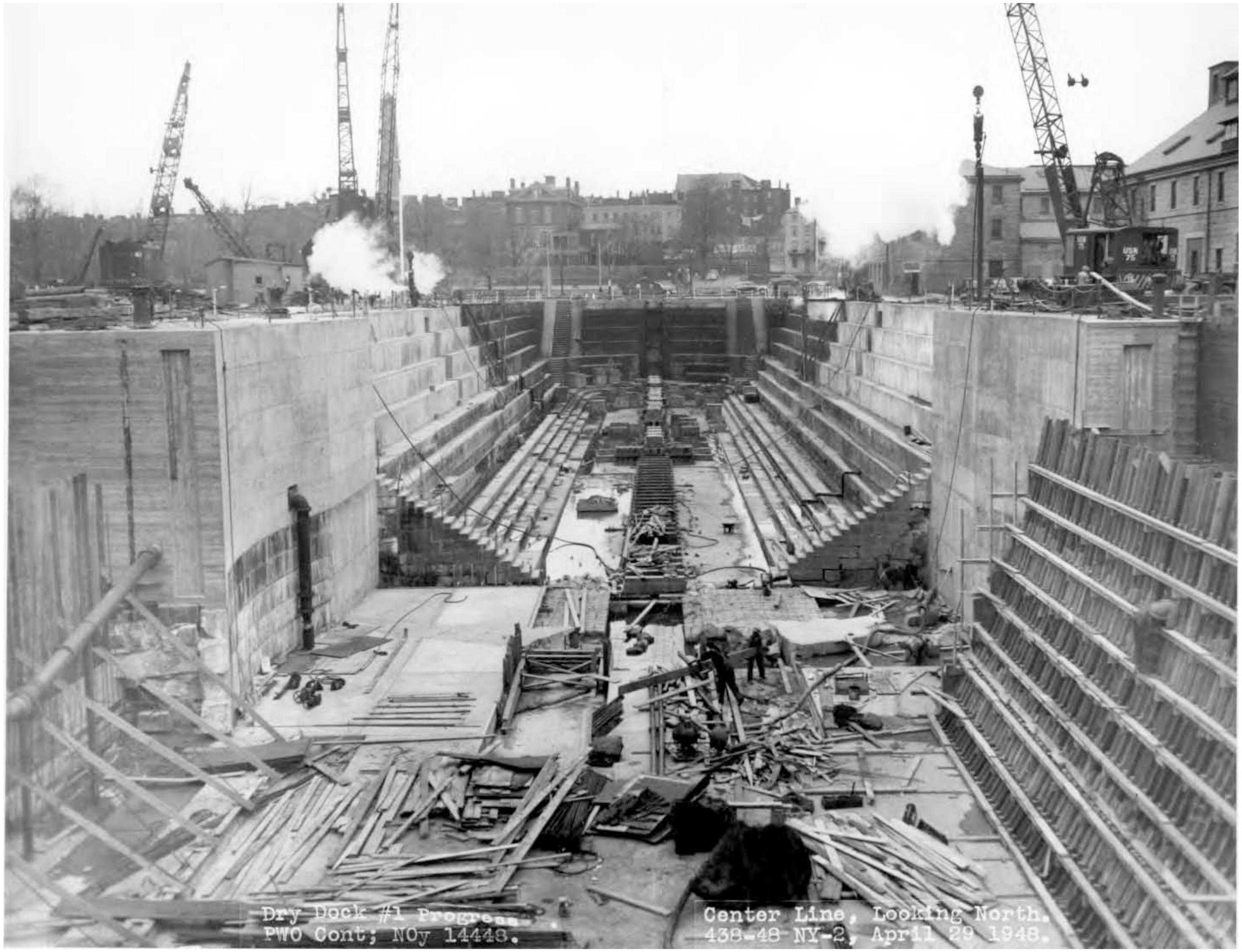


Fig. B-21 Photo BOSTS – 8796. April 29, 1948 view looking north toward the head of dock, taken during the construction of the seaward extension. Visible below the concrete, to the left, is the original stone wall, which was part of the basin where the timber turning gates were located.

Fig. B-22 Photo BOSTS – 8796. May 24, 1948 view looking south toward the seaward extension, following the completion of the reinforced concrete walls which replaced large sections of the original granite stone work.

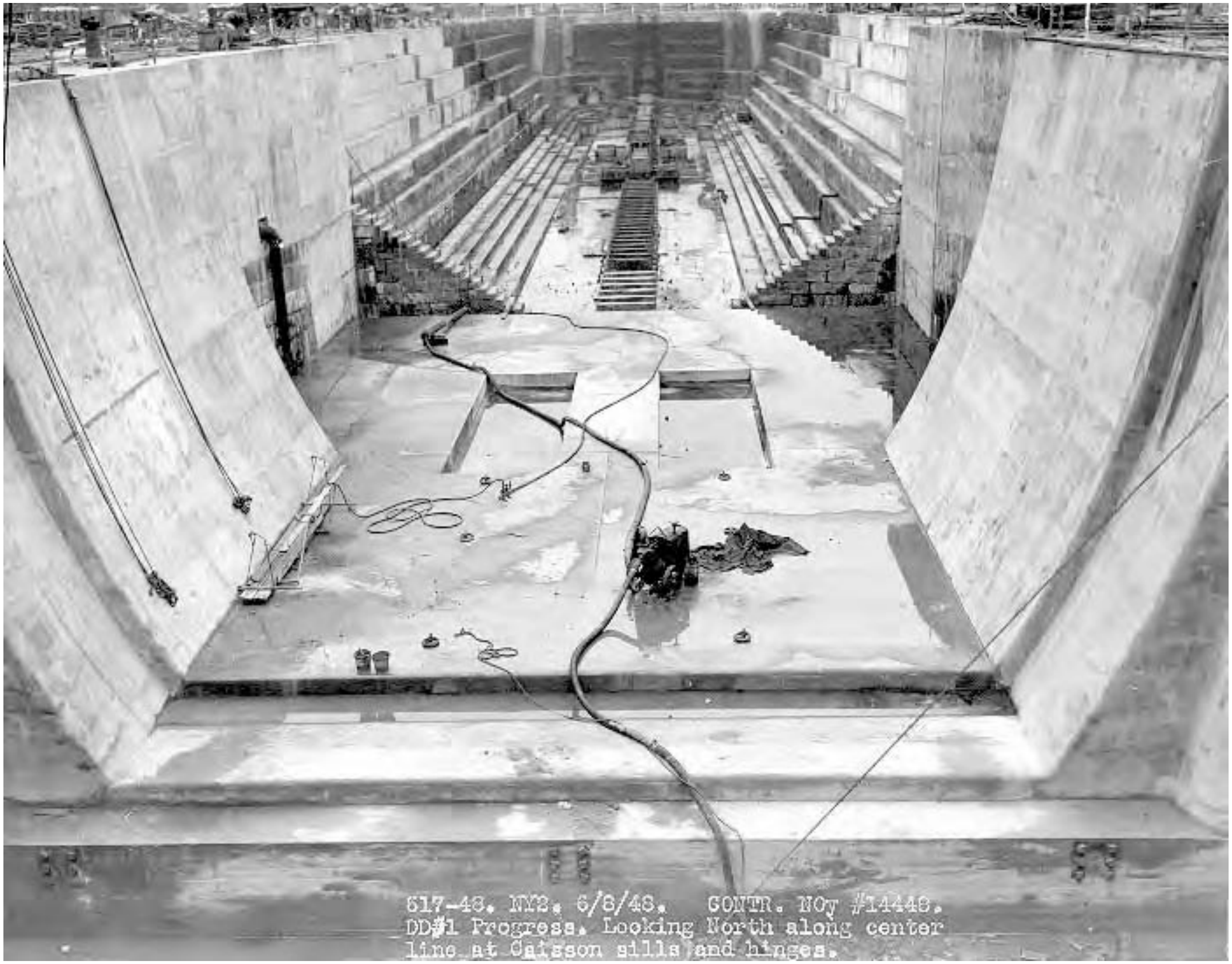


Fig. B-23 Photo BOSTS – 8796. June 8, 1948 view of the seaward extension, looking south, showing the completion of much of the reinforced concrete work. Note the propeller pit in the center and the new sills for seating the 1901 steel Caisson which remains in use today.

Fig. B-24 Photo BOSTS – 8796. July 1948 view looking southeast at relocated Capstan 3, including the capstan barrel, which rests on top of the newly constructed capstan pit.

Fig. B-25 Photo BOSTS – 8796. July 23, 1948 view, looking south, showing the seaward extension, by which time most of the construction work was completed. Note that the 1901 steel Caisson is in place.

Fig. B-26 Photo BOSTS – 8797. May 20, 1953 view of the east wall of Dry Dock 1, looking south, showing recently installed electrical cables, a portion of which remains today.

Fig. B-27 Photo BOSTS – 8800. June 1960 view of east wall at Stair 1 prior to the construction of the new tunnel intake and relocation of the stair. Note that the propeller pit had been enlarged, but retained its uniform edges, unlike the later expansion that drilled away additional sections of the concrete slab, leaving jagged edges that are visible today.

Fig. B-28 Photo BOSTS – 8800. July 25, 1960 view showing workers demolishing the original granite Stair 1 at the west wall near the seaward extension. This was done in advance of cutting a section through the west wall for the tunnel intake.

Fig. B-29 Photo BOSTS – 8800. November 1, 1960 view through a section of the west wall for the new tunnel intake. Workers blasted out some of the original granite masonry. A concrete-lined culvert was then built which decreased the amount of time needed to dewater the chamber. This photo shows some of the formwork for the new culvert. Note the stair above, the lower portion of which was demolished, prior to constructing a reinforced concrete stair to the left of this photo.

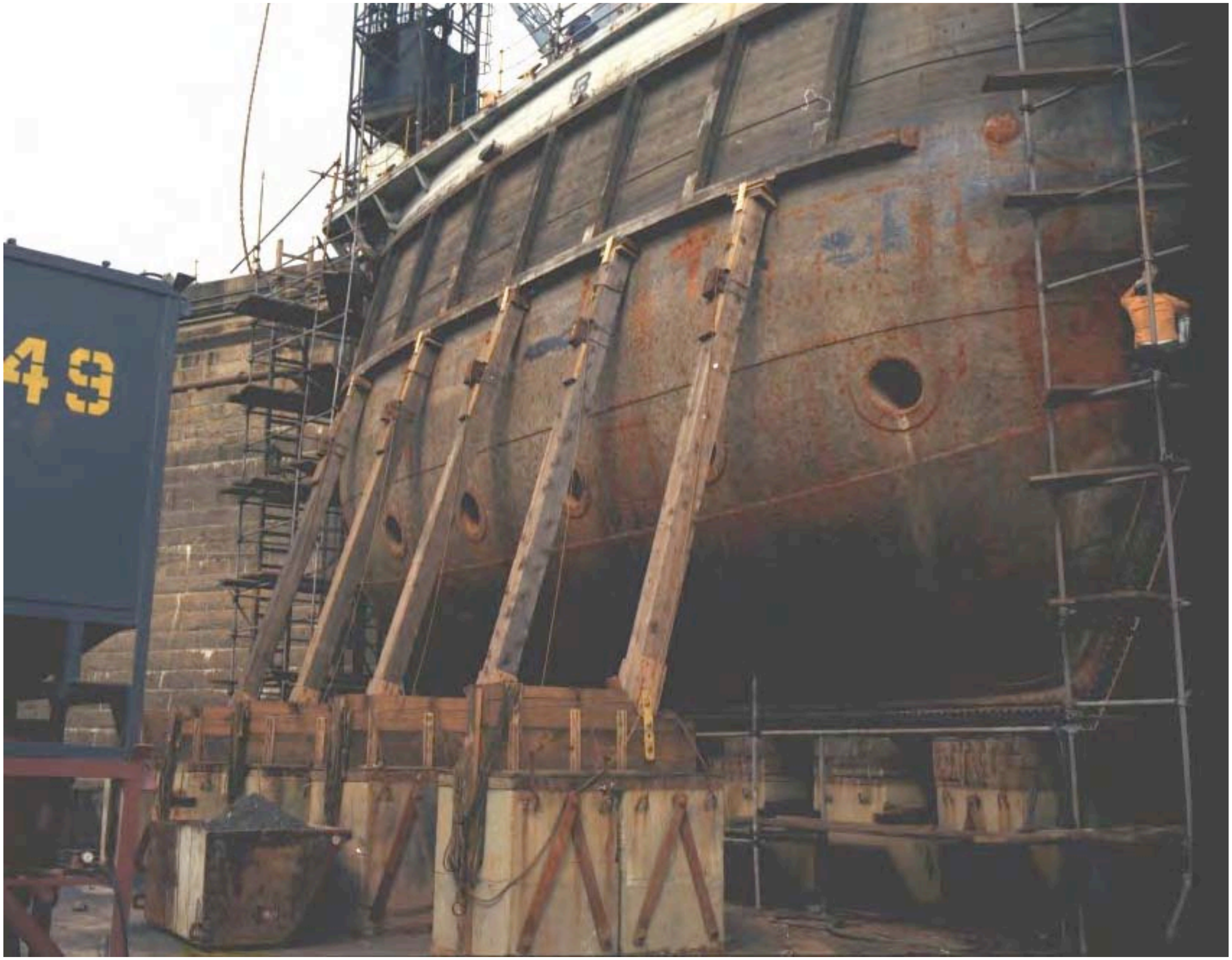


Fig. B-30 Photo BOSTS – 8805. September 13, 1972 view at Dry Dock 3 at South Boston of the steel Caisson undergoing its last renovation before closure of the Navy Yard.

Appendix C | Historic Drawings

Note on the Historic Drawings

Original Loammi Baldwin Drawings:
Loammi Baldwin's general plans, elevations, and details of Dry Dock 1 were presented to the U.S. Navy in what appears to be several proposal drawings that are bound and archived at the Baldwin Collection of the William L. Clements Library at the University of Michigan, Ann Arbor. (The earliest of these drawings is dated December 1826; however, a number of others date from the early 1830s.) These early drawings and others cited were damaged and showed signs of age. Library staff did not permit the bound drawings to be disassembled and reproduced. Instead, the drawings were photographed, using a digital camera. A selection of these drawings has been reproduced as digital images which appear in **Part I** of this appendix.

Redrawn Loammi Baldwin Drawings:
Robert Stewart analyzed the digital photographs of the Baldwin drawings and redrew several of them, enhancing faded or weak lines, and eliminated staining or blotches that are a result of aging and wear. Stewart used a modern graphic font to distinguish his dimensions and handwritten notes from the original delineations. He then reproduced these reworked drawings as digital black-and-white line drawings. In addition, Stewart developed composite drawings to portray key features of Baldwin's original design. The redrawn Baldwin drawings are presented in **Part II** of this appendix.

Drawings from the Boston National Historical Park Archives:
The Boston Naval Shipyard engineering plans of Dry Dock 1 were reviewed at the Boston National Historical Park Archives at the Charlestown Navy Yard. Based on the research and analysis of these drawings, several of the most informative, which provide an understanding of the major changes to the dock over time, were scanned and are included in **Part III** of this appendix.

Part I: Original Loammi Baldwin Drawings

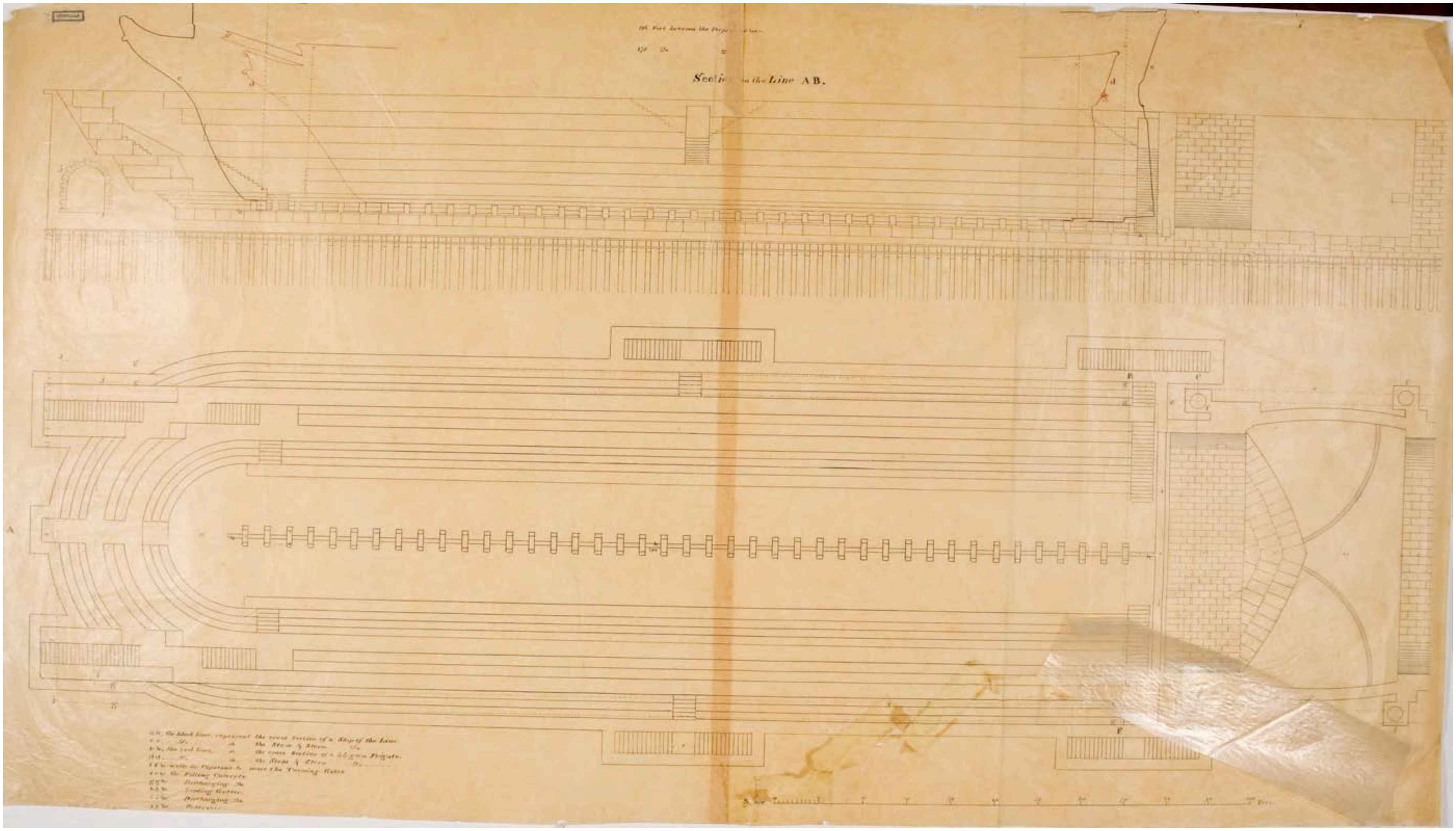


Fig. C1 Plan and section of Dry Dock 1, with outline of a frigate and a ship-of-the-line, "ghosted" into the section, 1826.

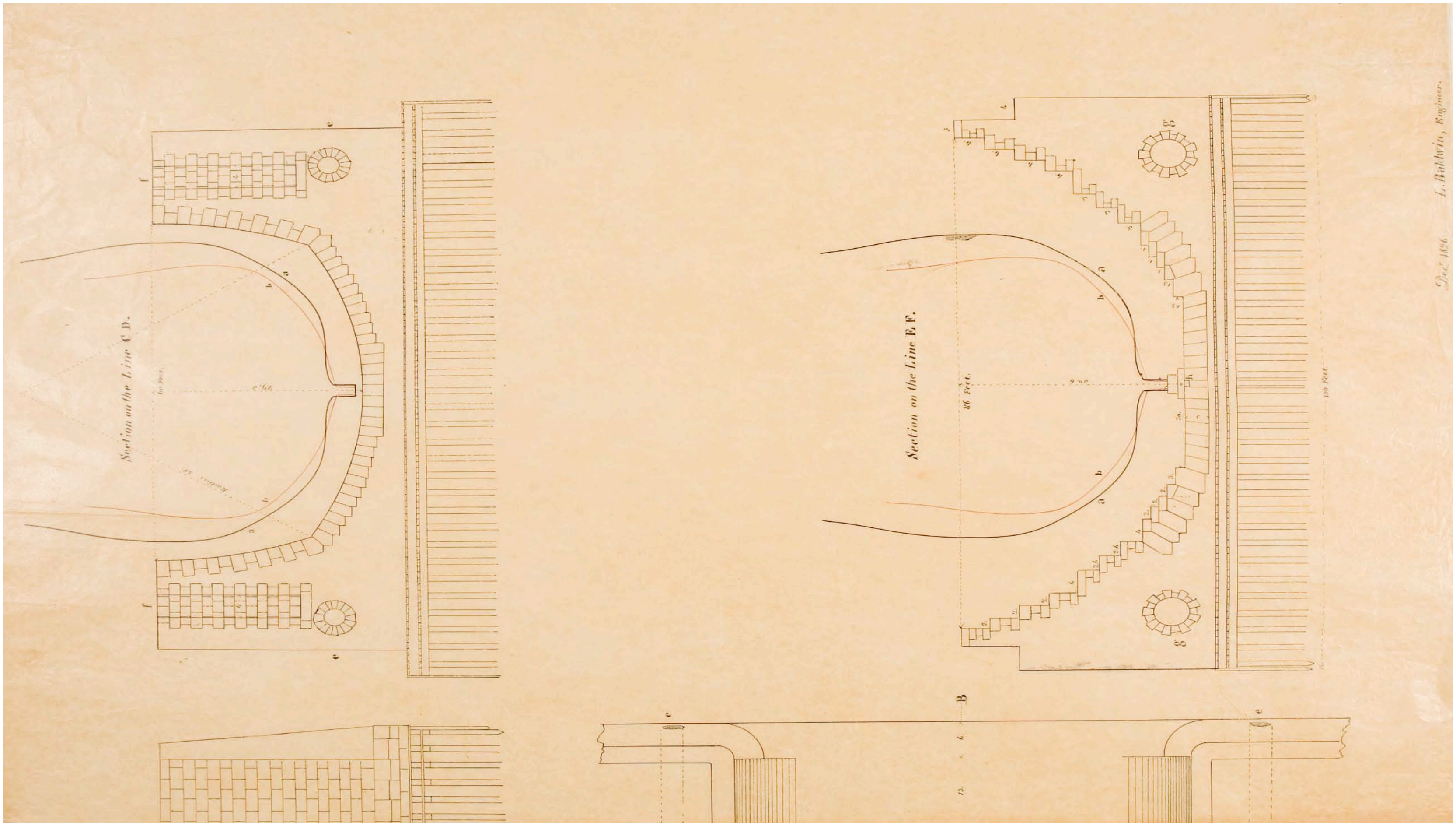


Fig. C2 Section through chamber with vessel ghosted along centerline of dry dock, dated Dec. 1826.

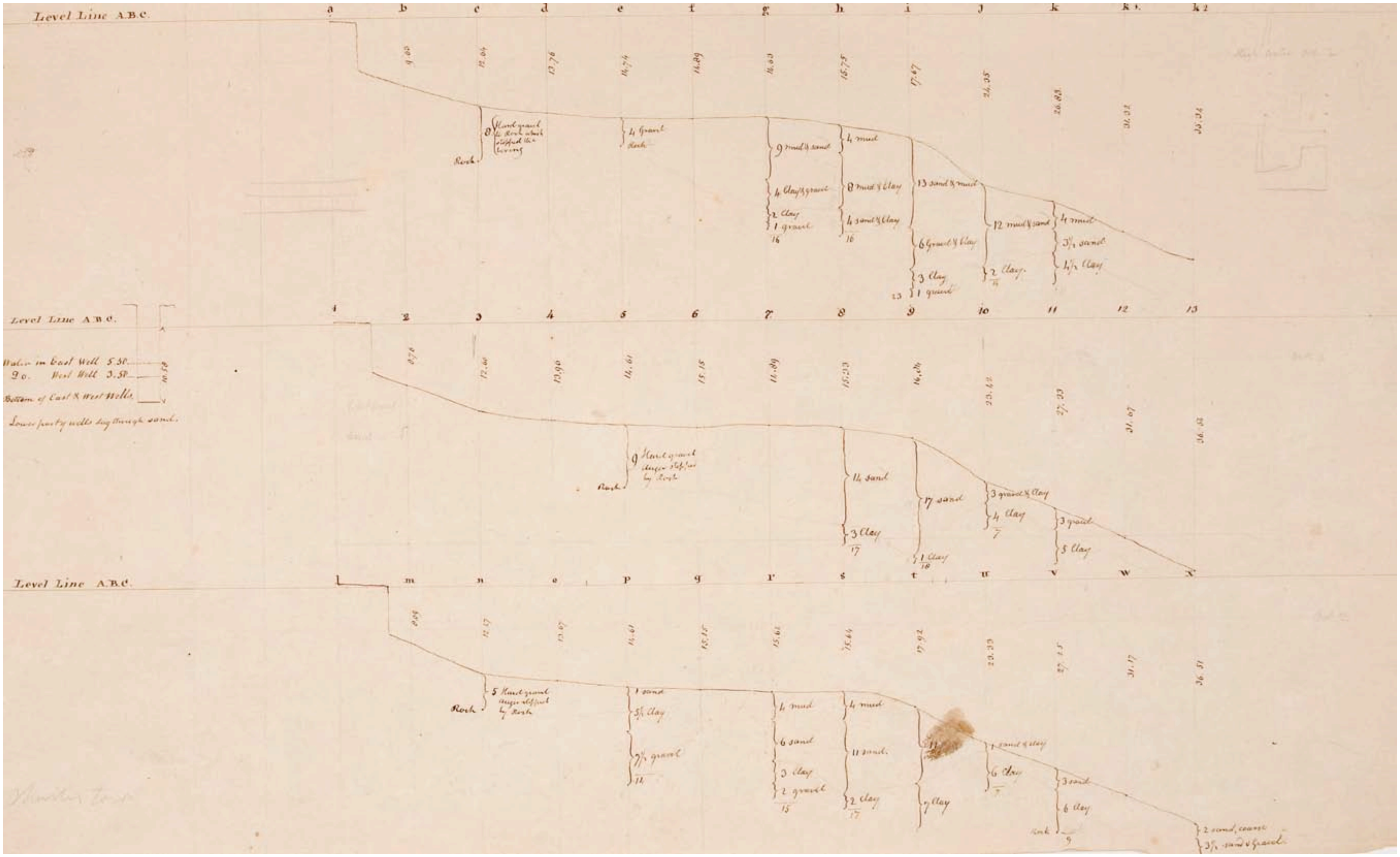


Fig. C3 Soil conditions, survey levels, and locations of boring samples at site of Charlestown dry dock, [ca. 1826].

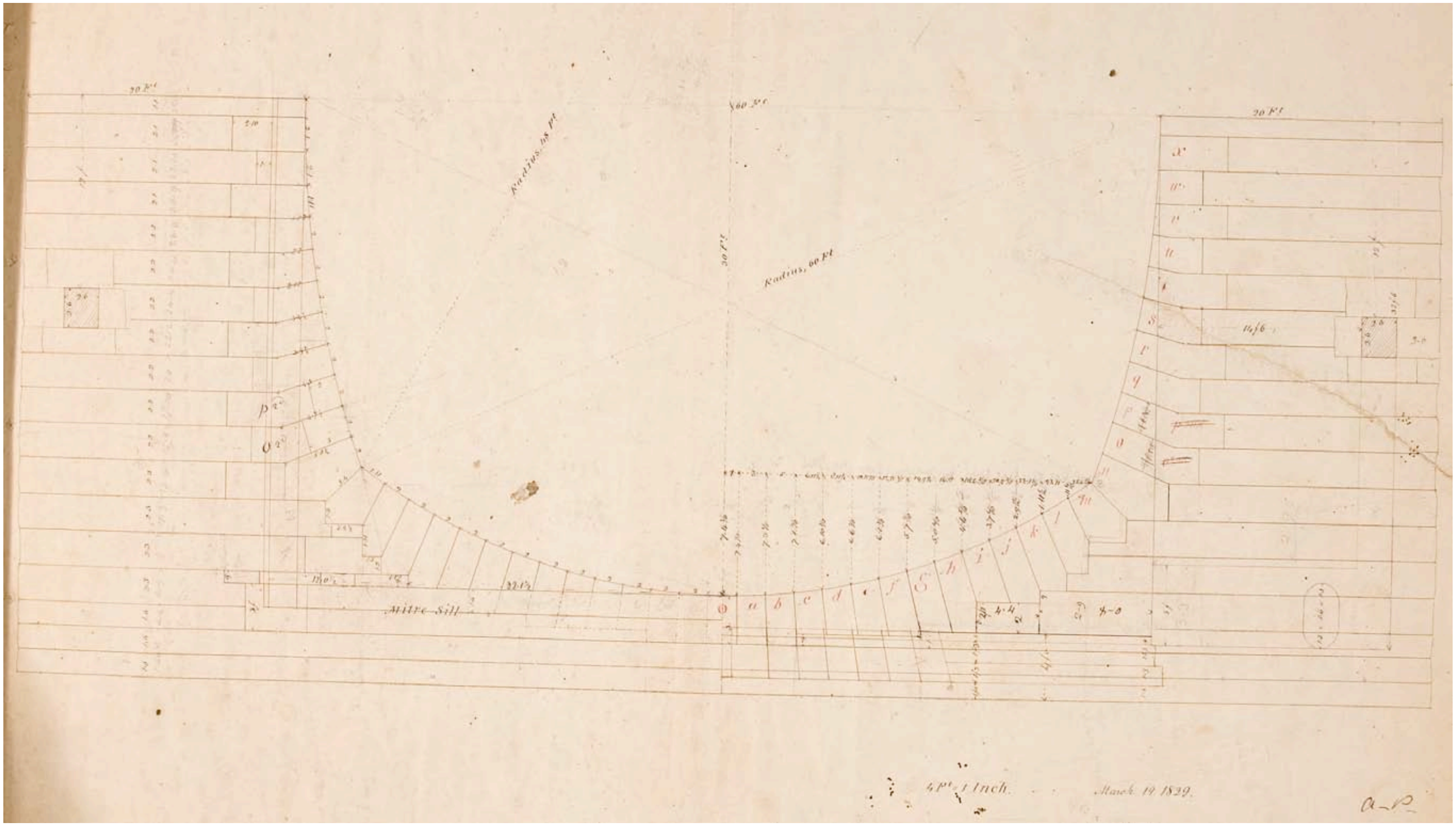


Fig. C4 Section of dry dock, dated March 19, 1829.

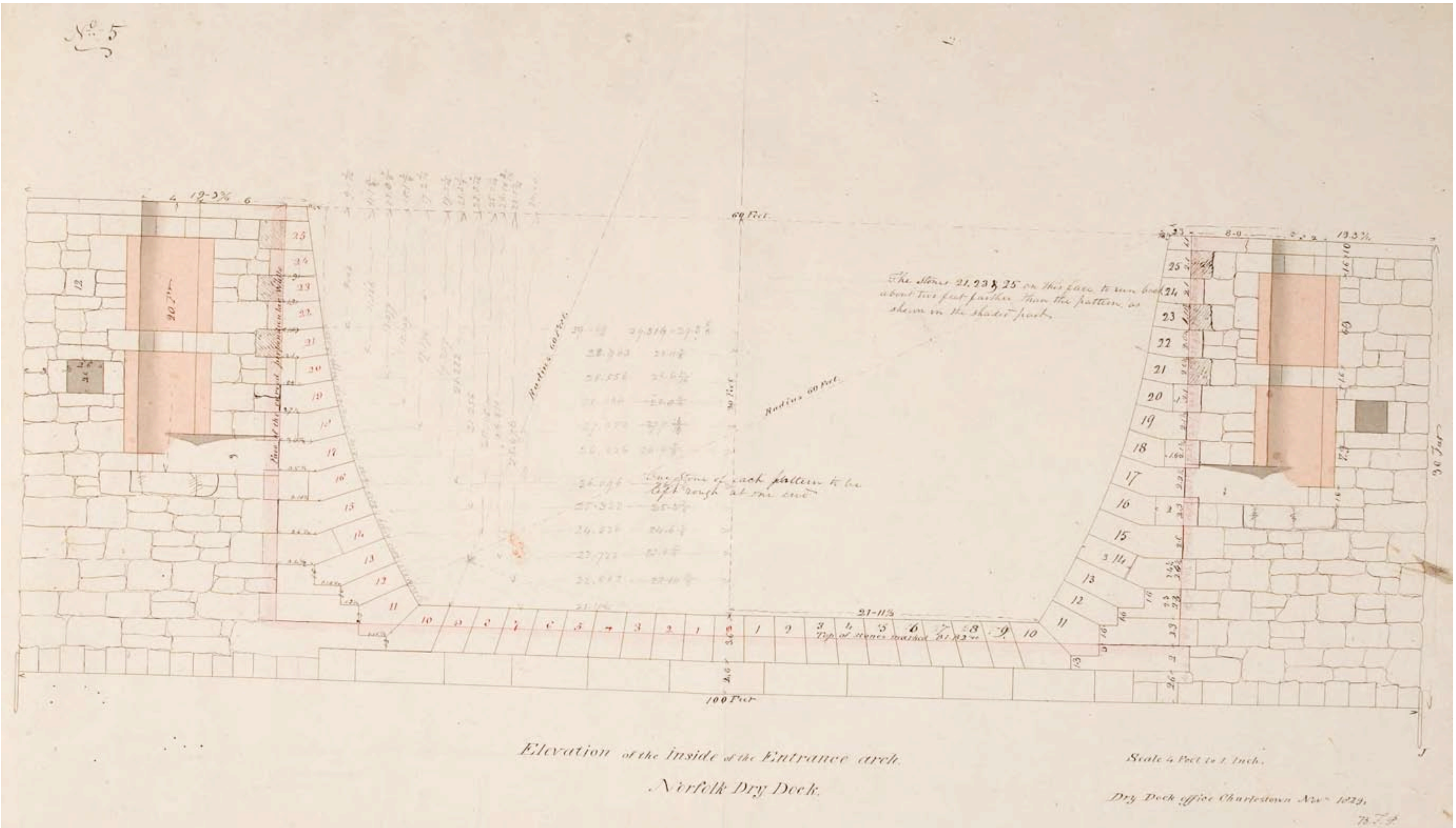


Fig. C5 "Elevation of Inside of the Entrance Arch, Norfolk Dry Dock," November 1829. The design drawings for the Gosport [Norfolk] Dry Dock were produced at the Charlestown Navy Yard. The design of the two dry docks contained many similar structural and architectural elements.

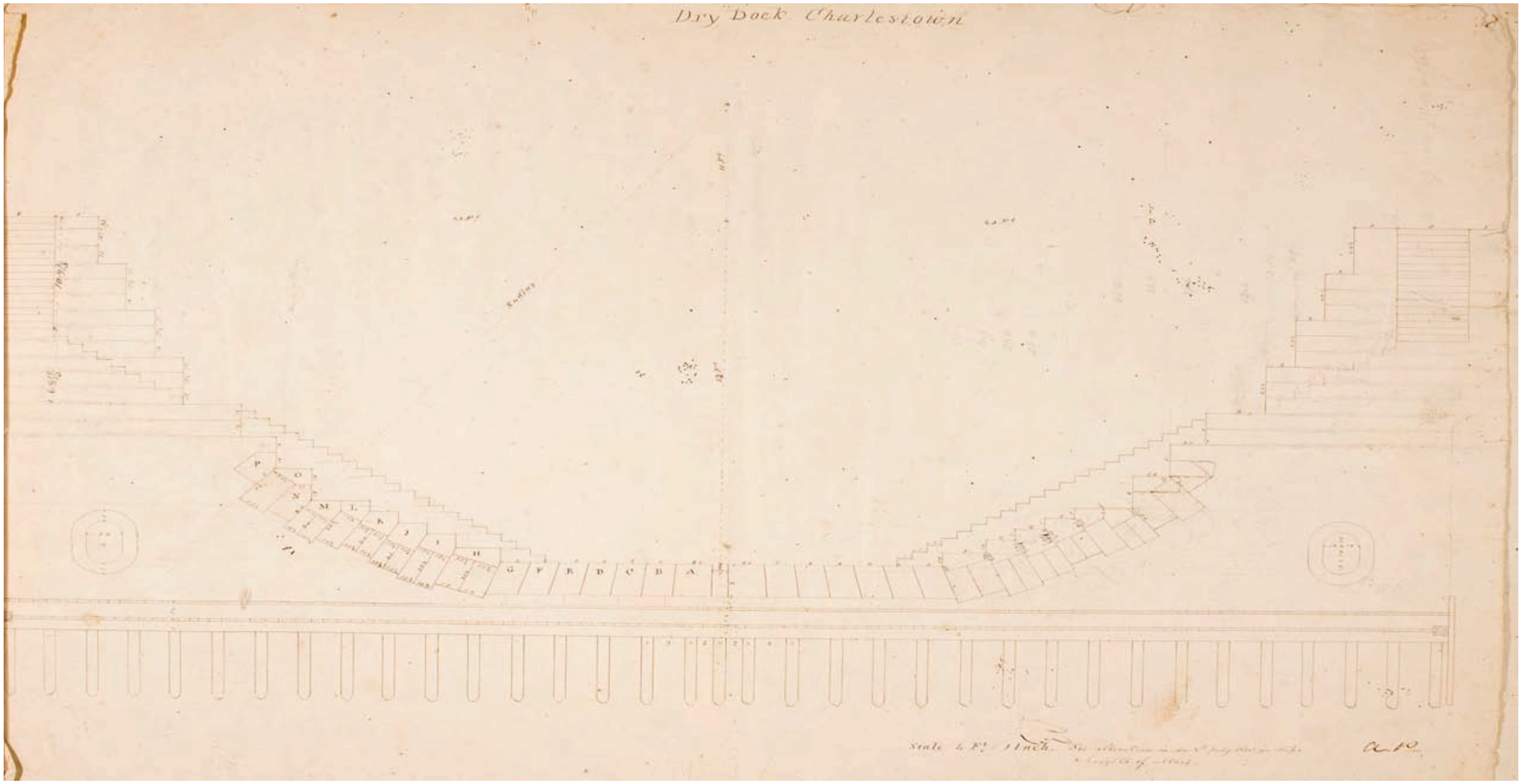


Fig. C6 Section of dry dock, showing substructure (not dated, signed "A.P.", Alexander Parris).

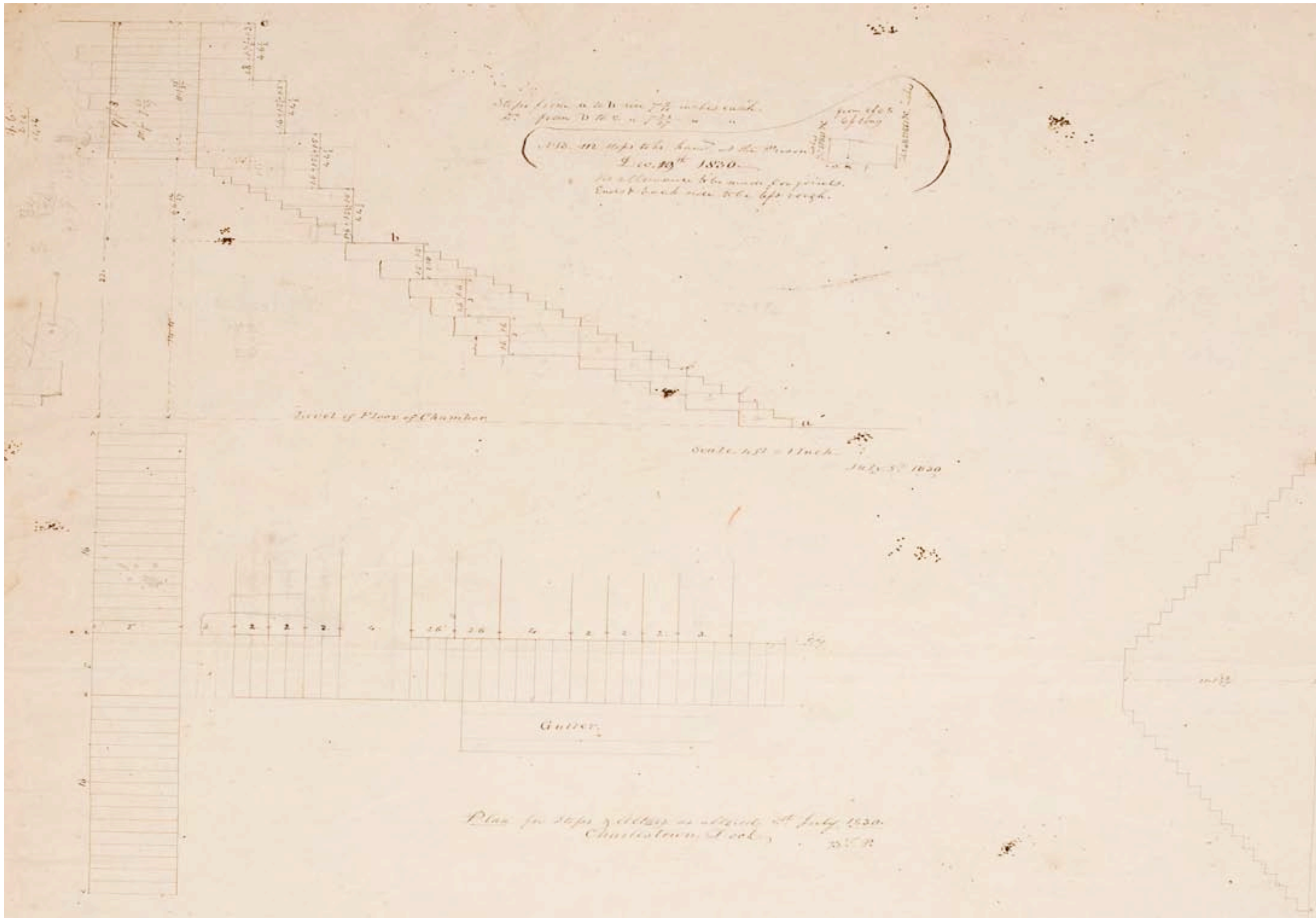


Fig. C7 “Plans for Steps and Altars as Allowed, Charlestown Dock,” July 8, 1830.

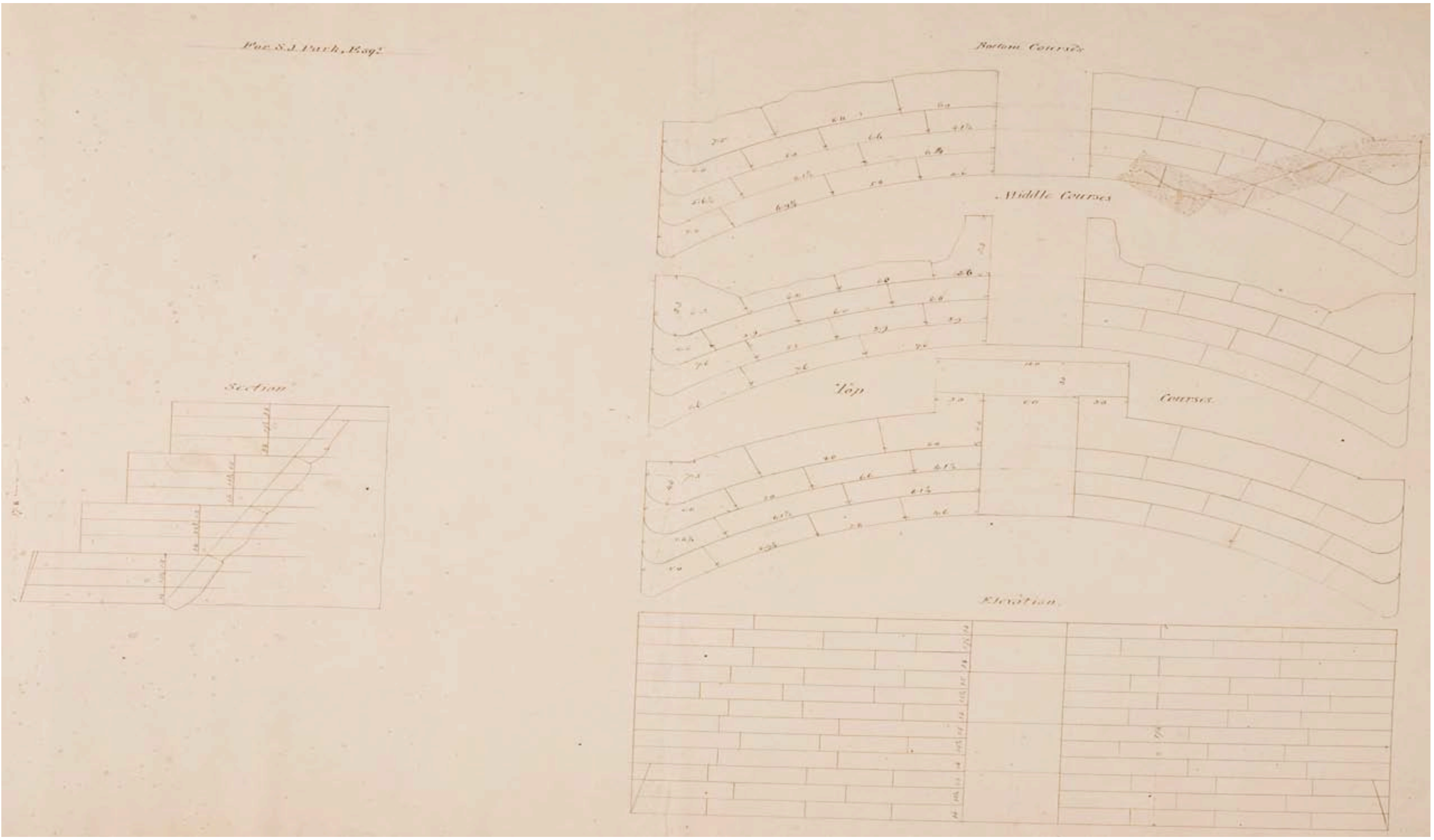


Fig. C8 Plan, elevation, and section of head of dock, no date.

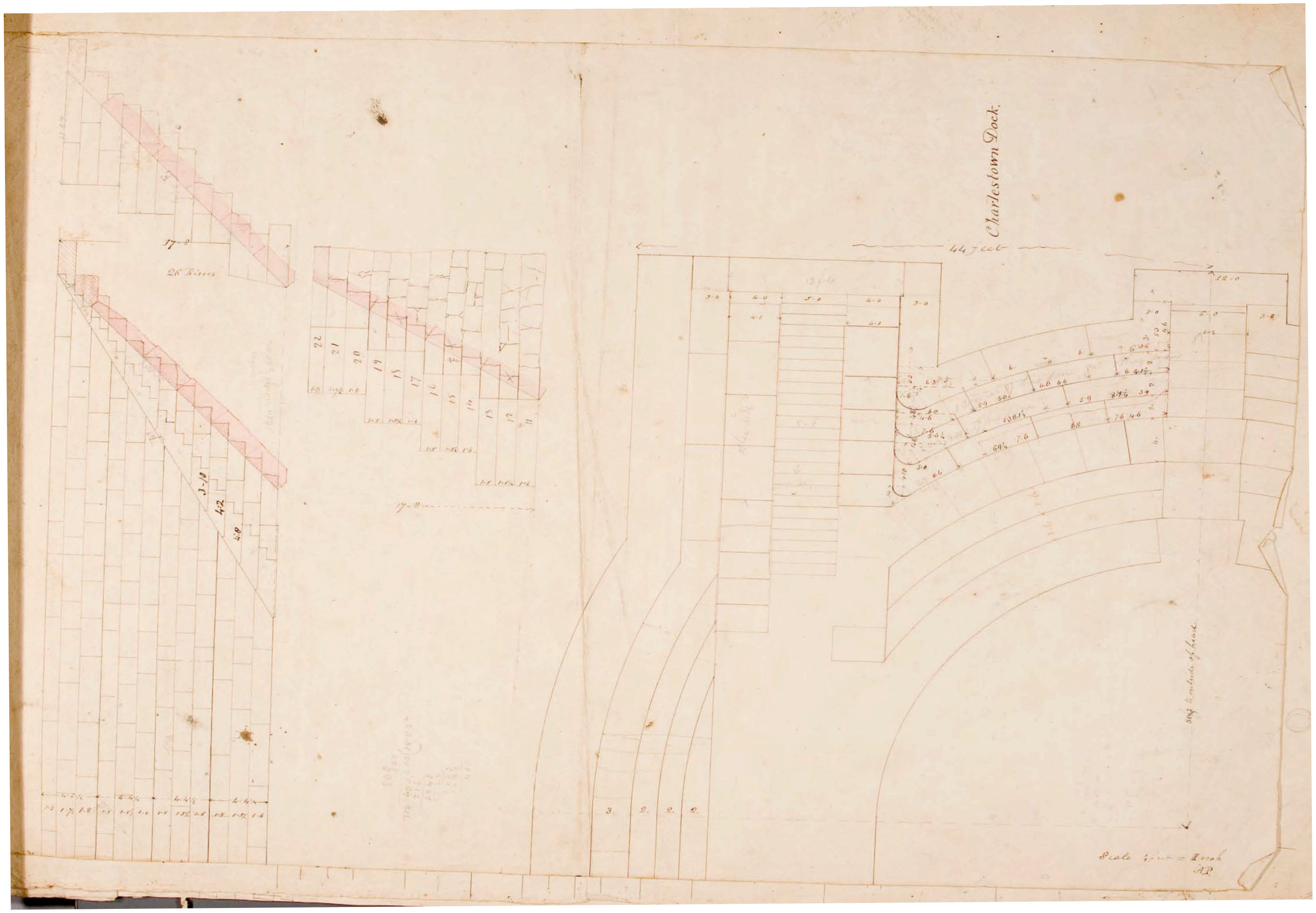


Fig. C9 Plan and elevations of head of dock and stairs, no date, signed "A.P.", (Alexander Parris).

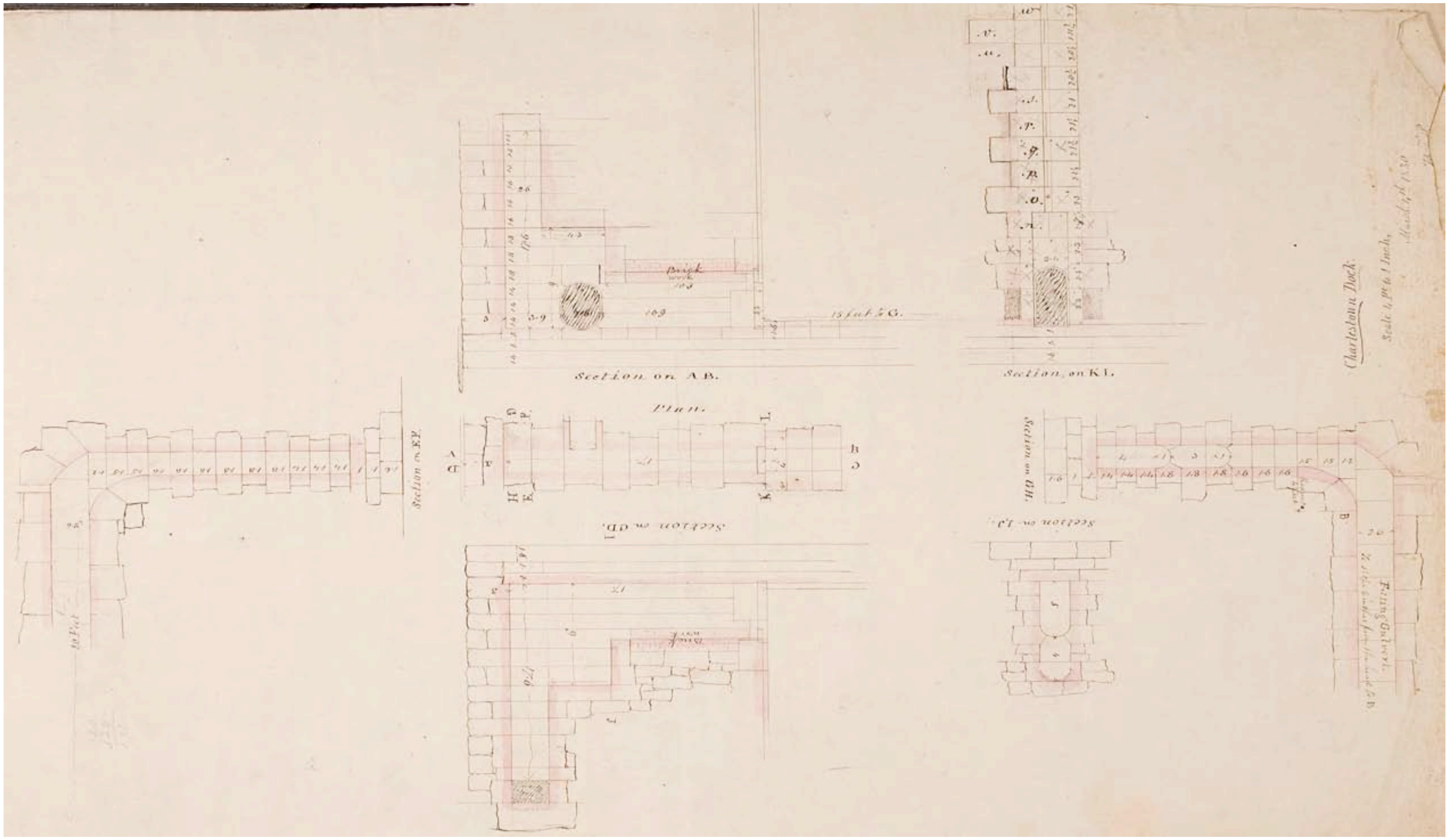


Fig. C10 Sections of dry dock walls showing culverts, dated March 4, 1830.

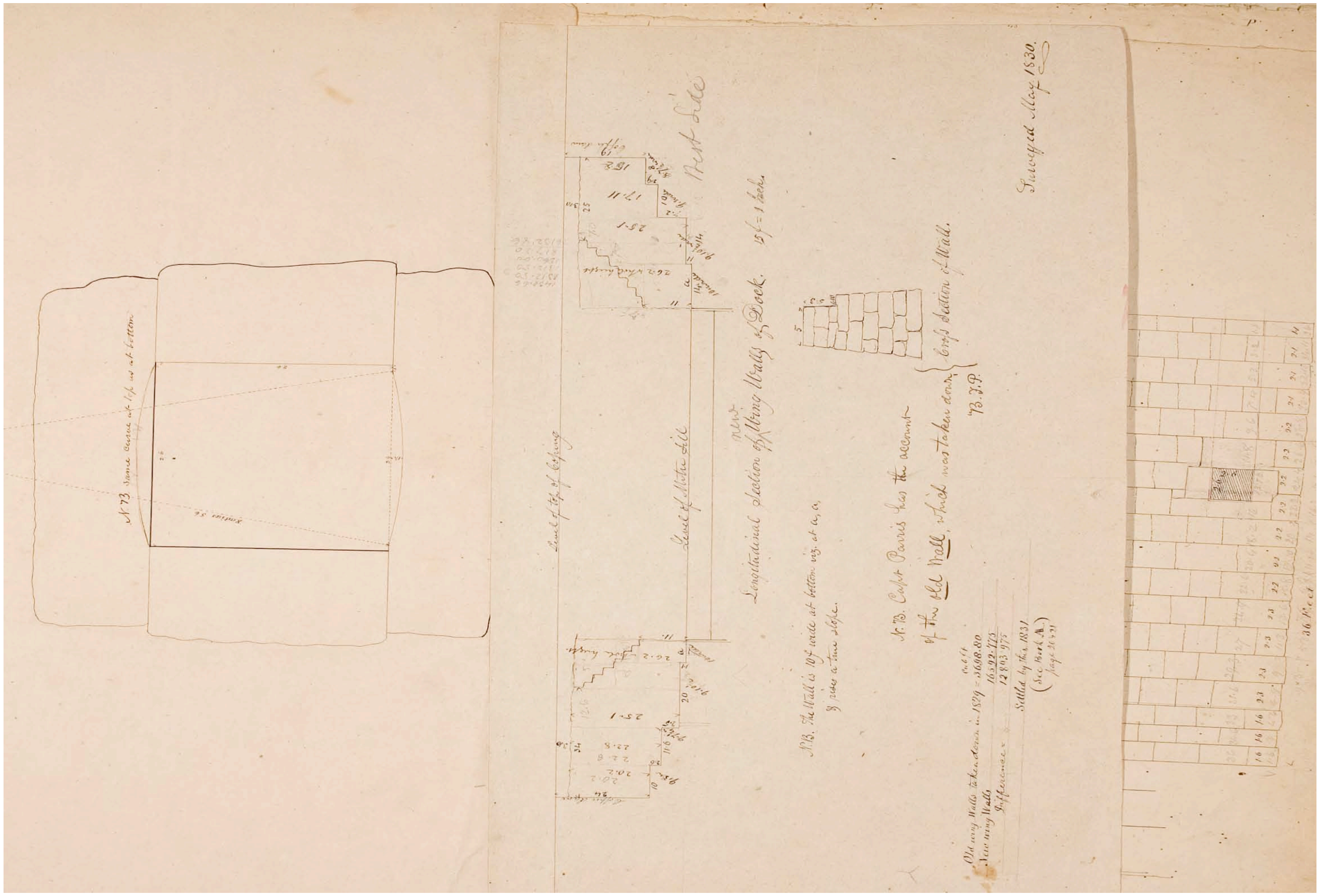


Fig. C11 "Longitudinal Section of New Wing Wall of Dock", May 1830.

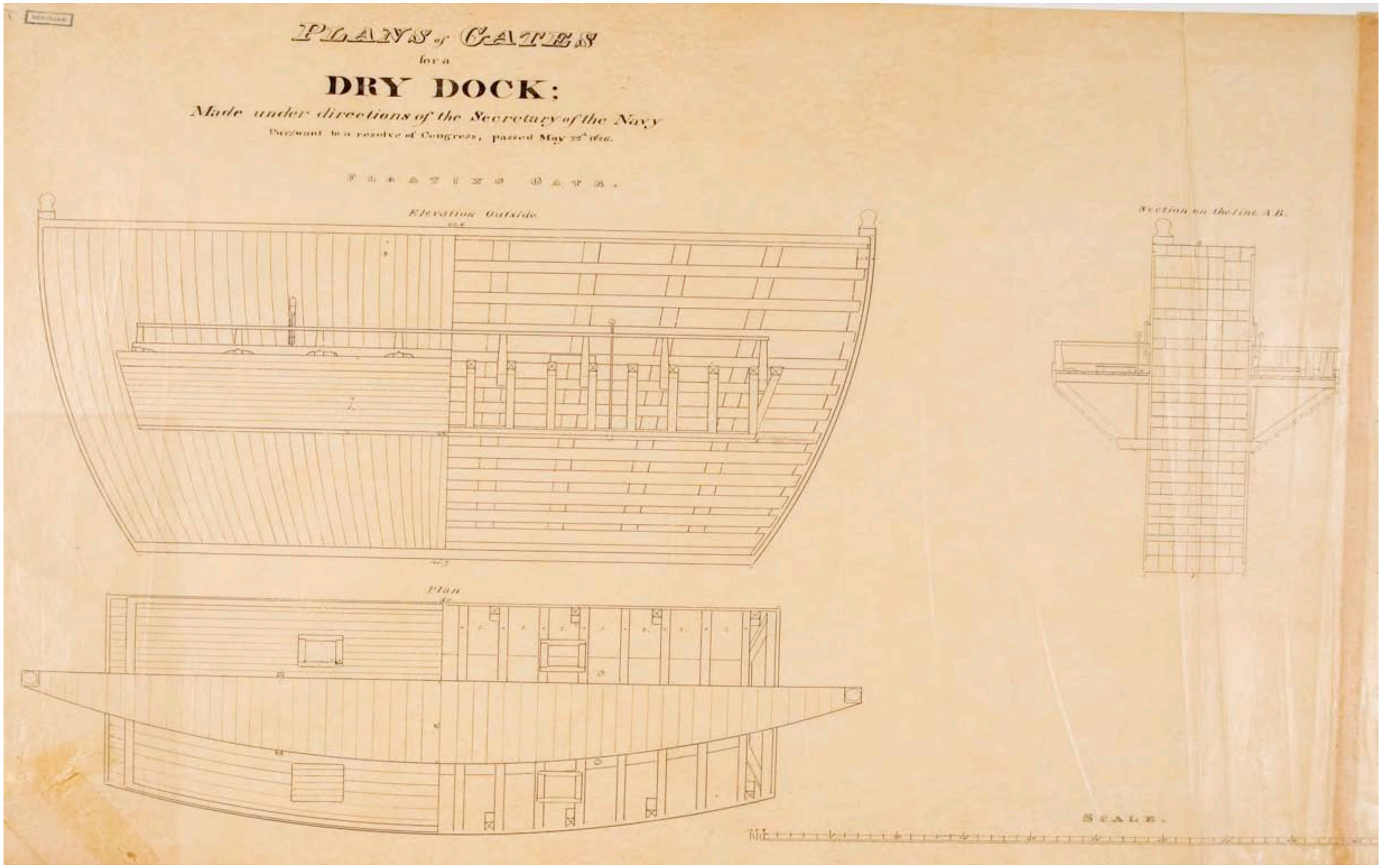


Fig. C12 "Plans of Gates for a Dry Dock," [sheet 1 of 2], May 22, 1826.

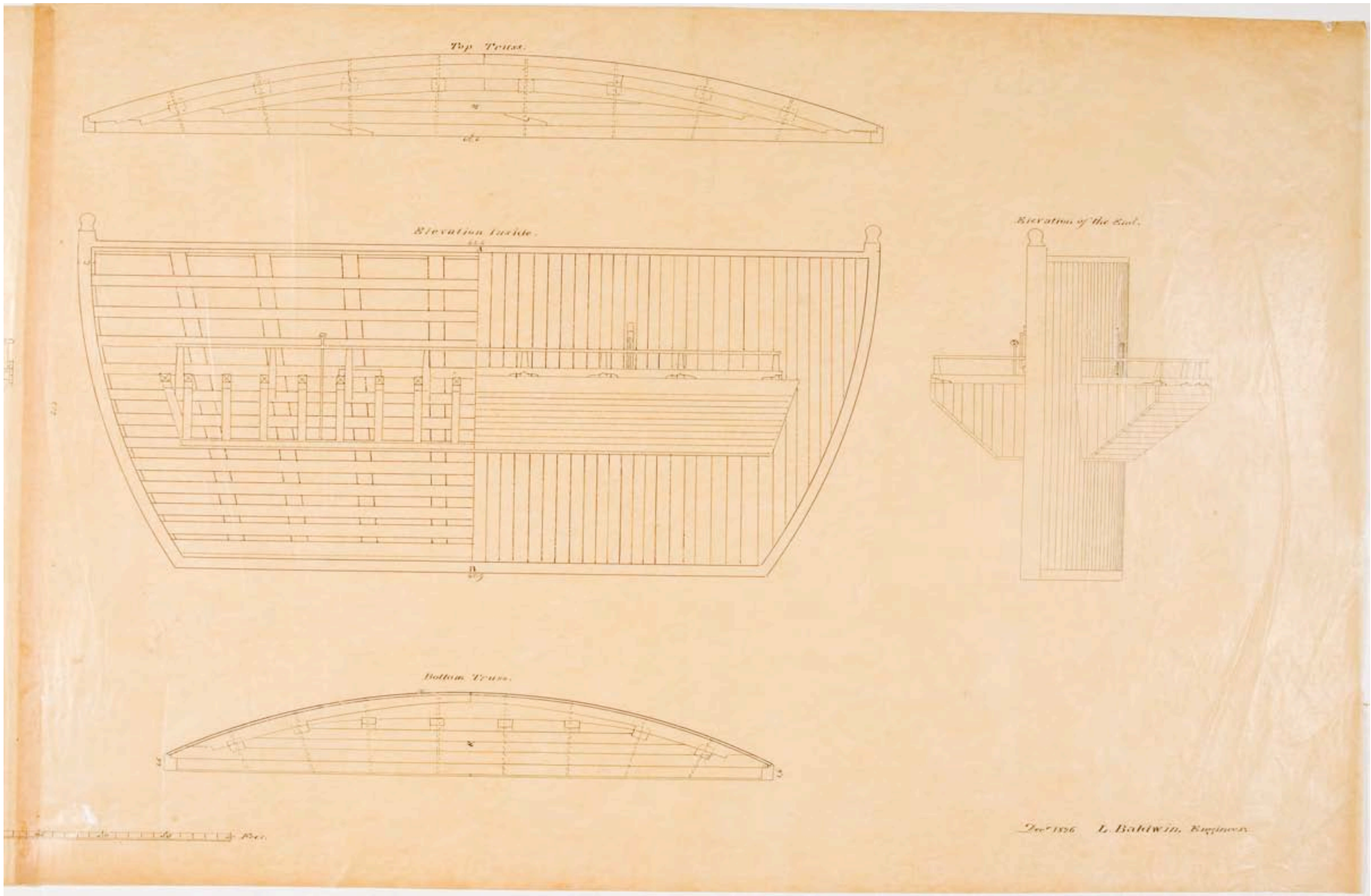


Fig. C13 "Plans of Gates for a Dry Dock," [sheet 2 of 2], May 22, 1826

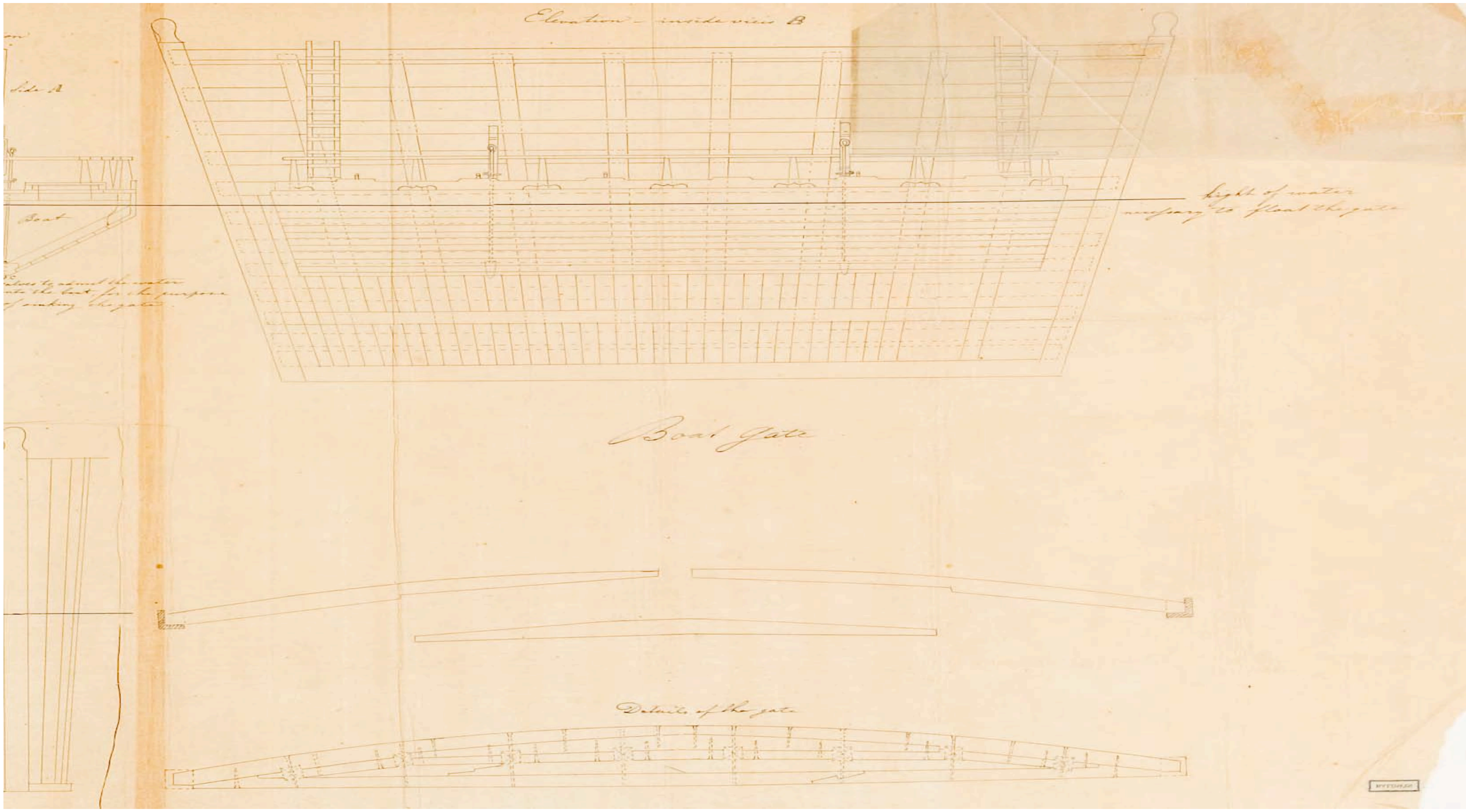


Fig. C14 "Boat Gate," including elevation and details of the gate [sheet 1 of 2], no date [ca. 1826].

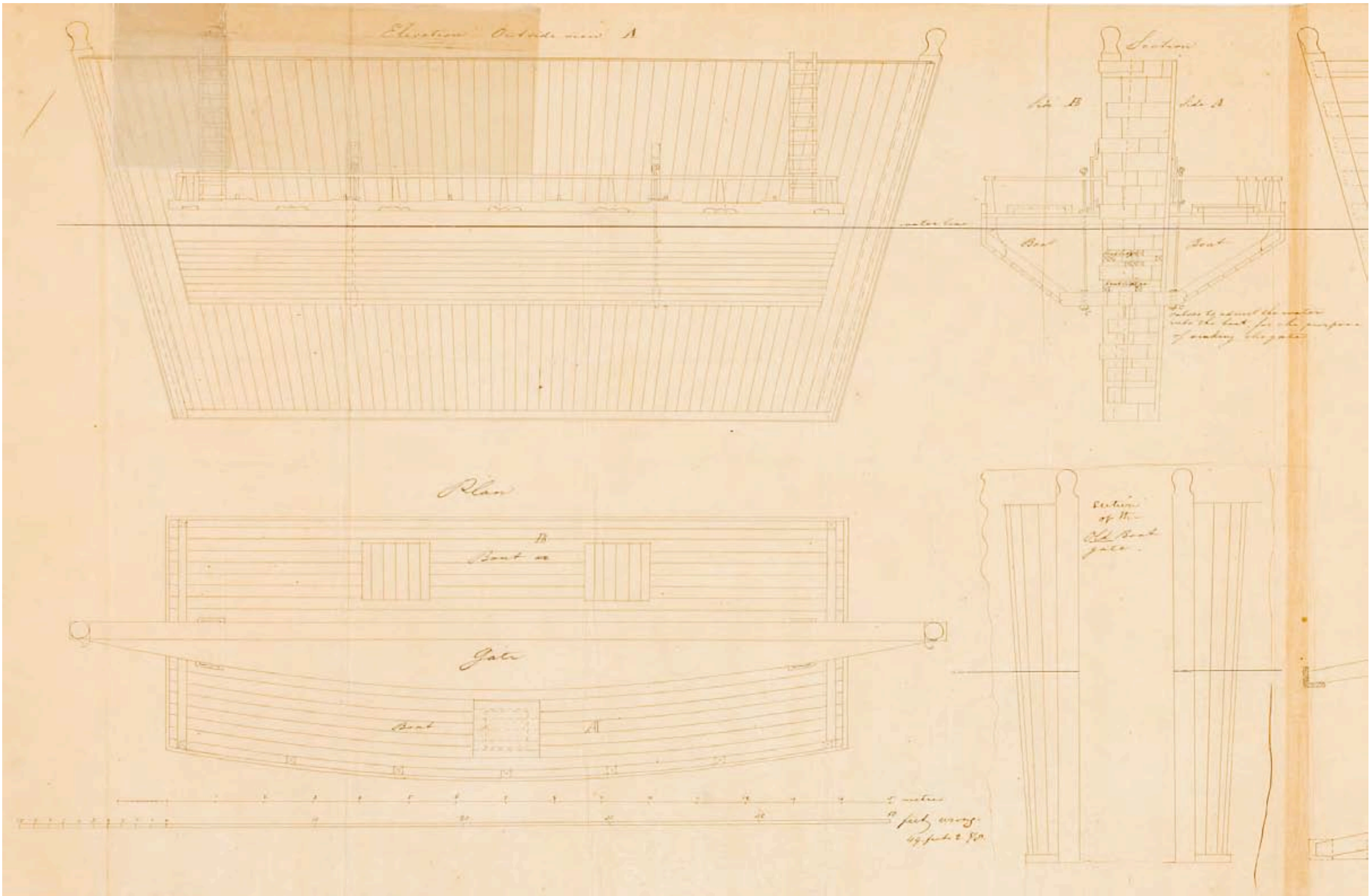


Fig. C15 "Boat Gate," including elevation, plan, and section of the gate [sheet 2 of 2], no date [c. 1826].

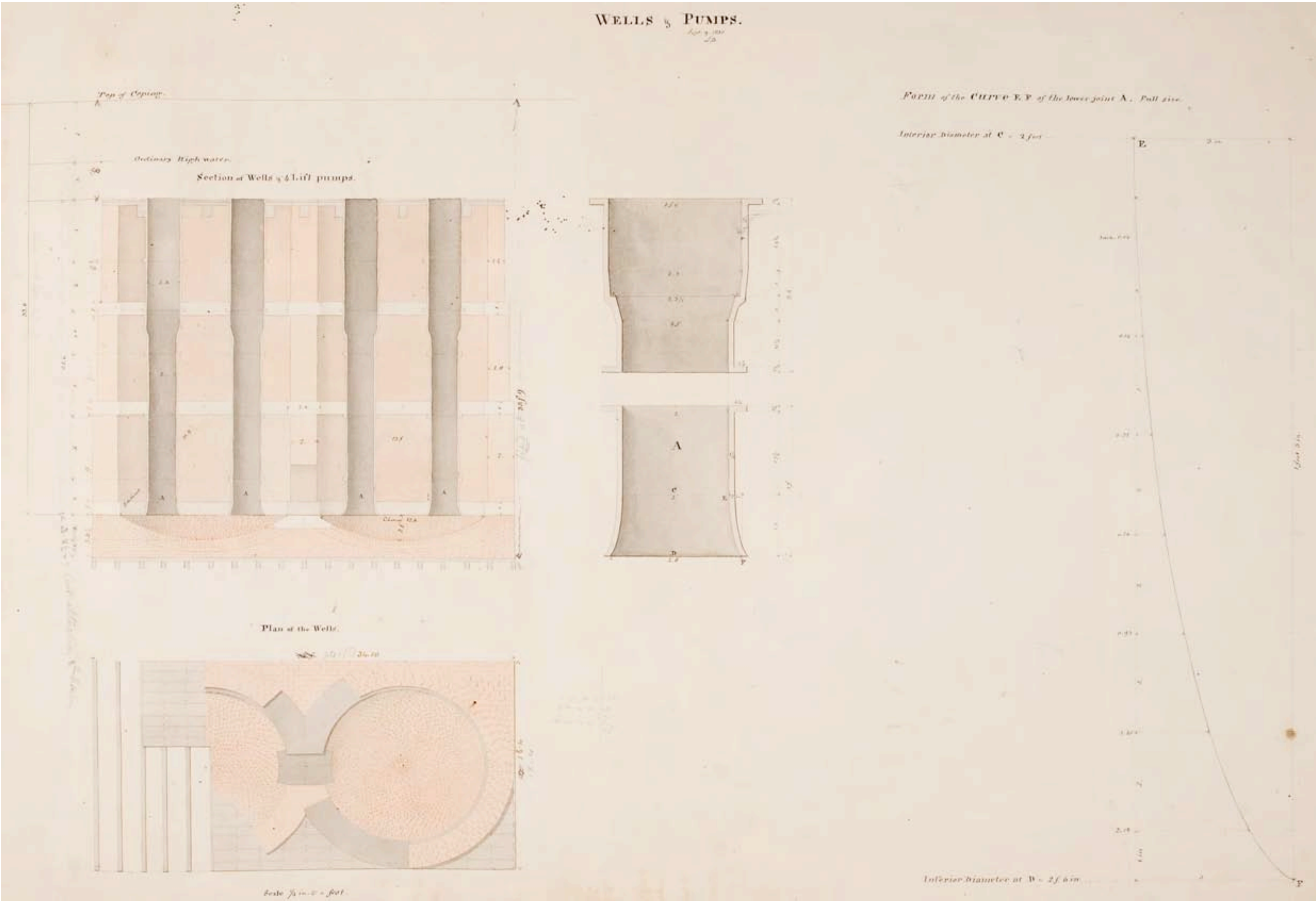


Fig. C16 "Wells & Pumps," September 9, 1830.

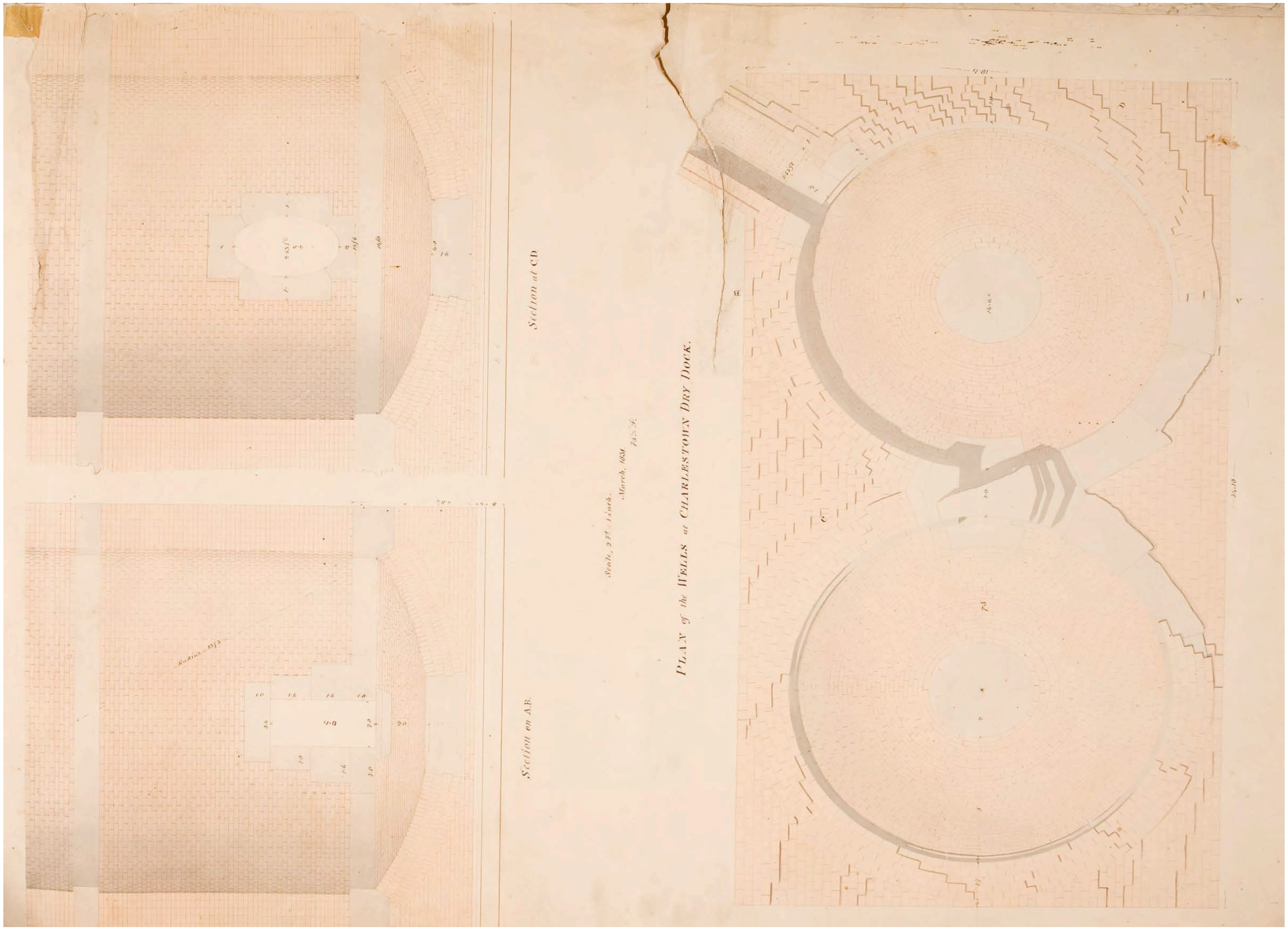


Fig. C17 "Plans of the Wells at the Charlestown Dry Dock," March 1834.

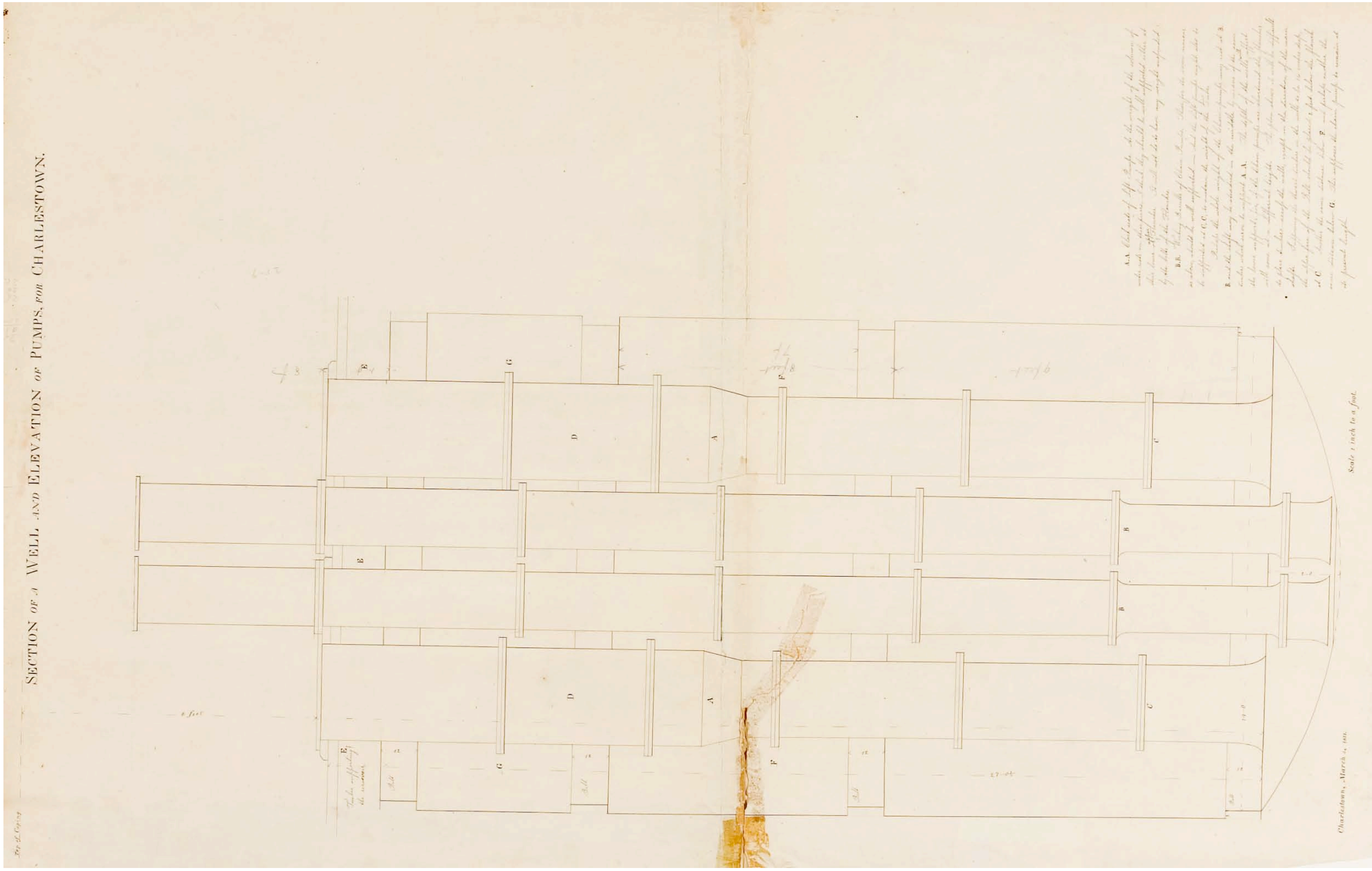


Fig. C18 "Section of Well and Elevations of Pumps for Charlestown," March 5, 1831.

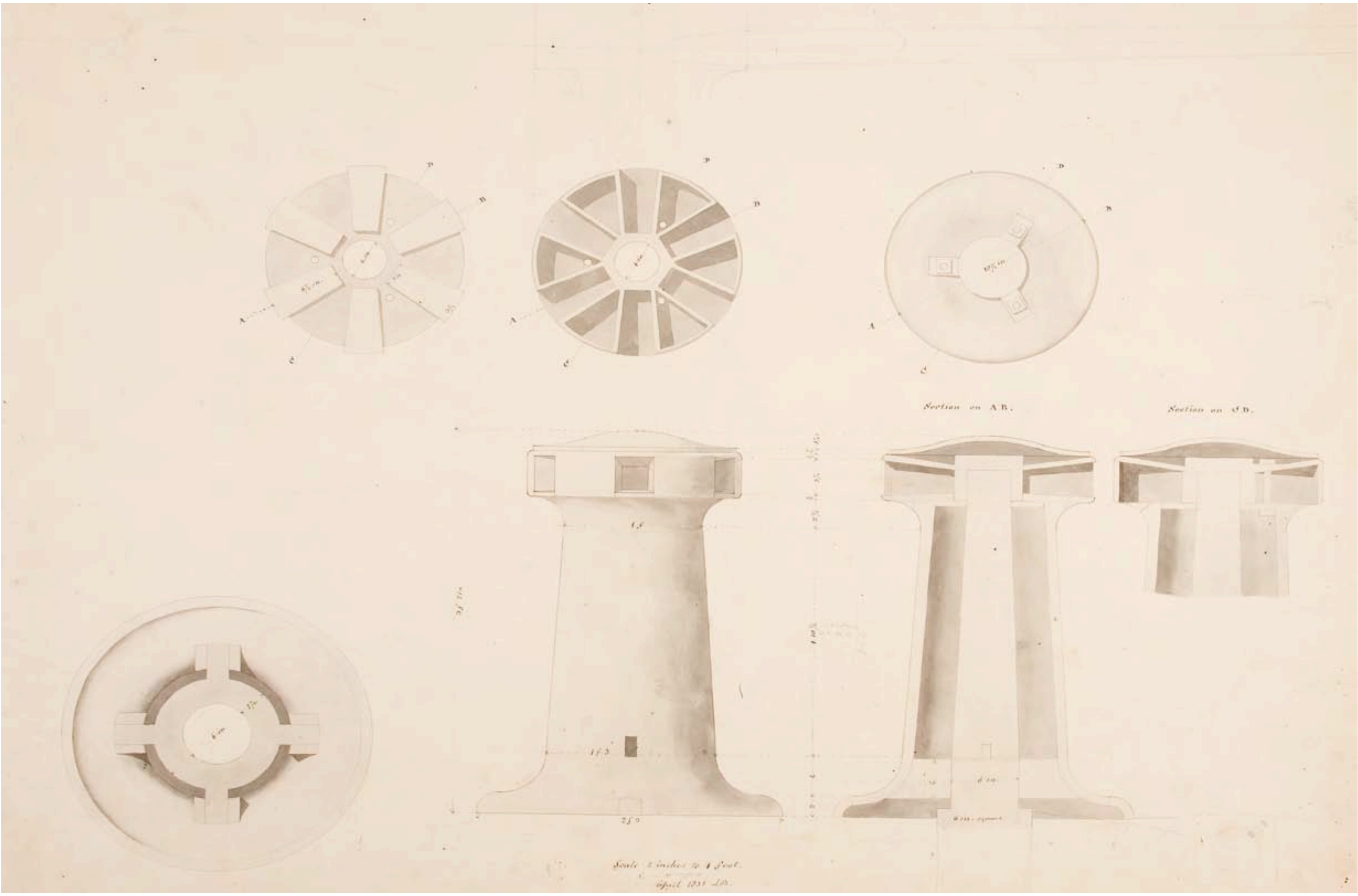


Fig. C19 Plan, sections, and details of capstan, dated April 1831.

Part II: Redrawn Loammi Baldwin Drawings

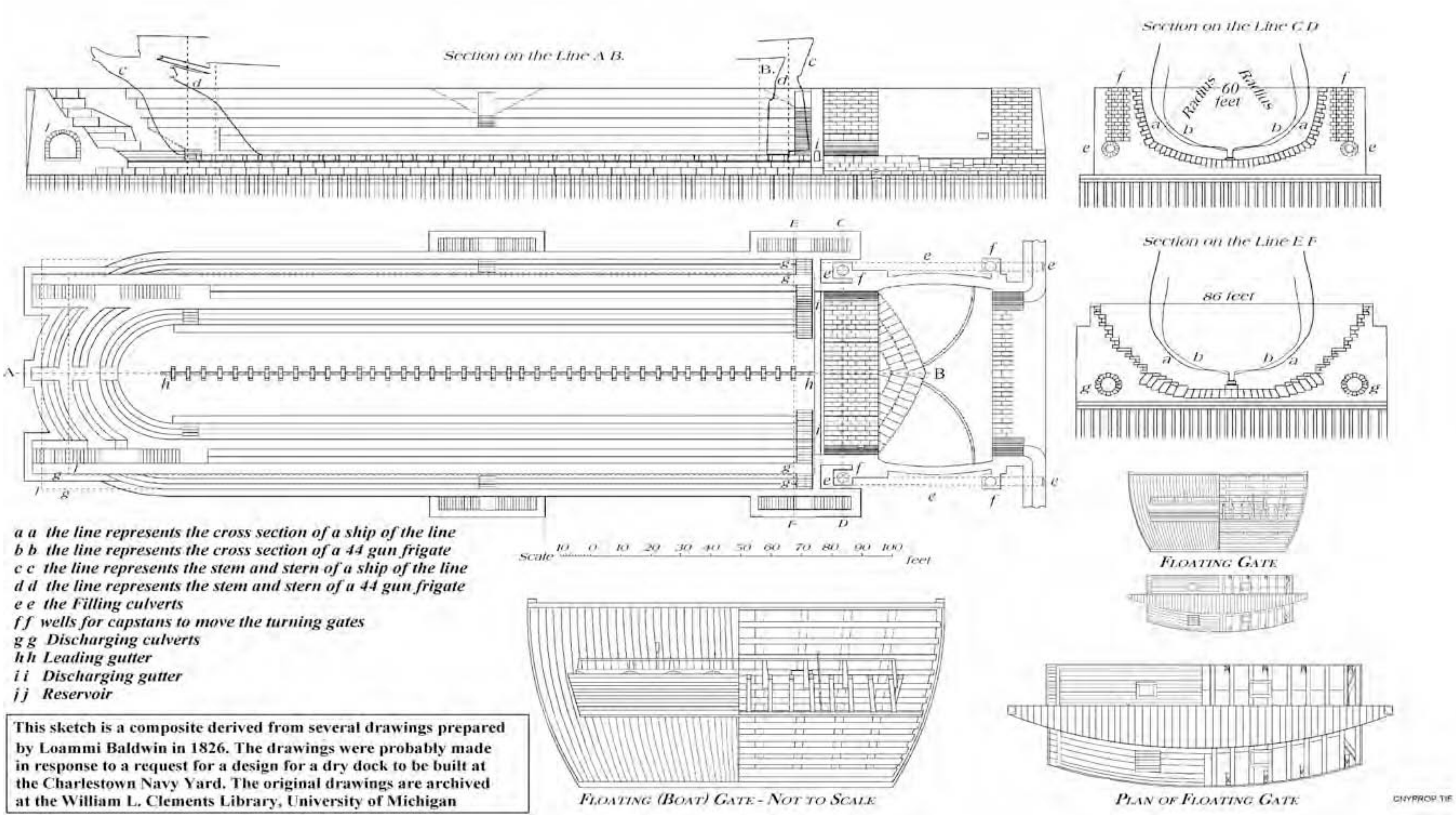


Fig. C20 Plan, elevations, and sections of dry dock, and floating gate, adapted from several original drawings prepared by Loammi Baldwin in 1826. This composite drawing was executed by Robert Stewart in November 2005.

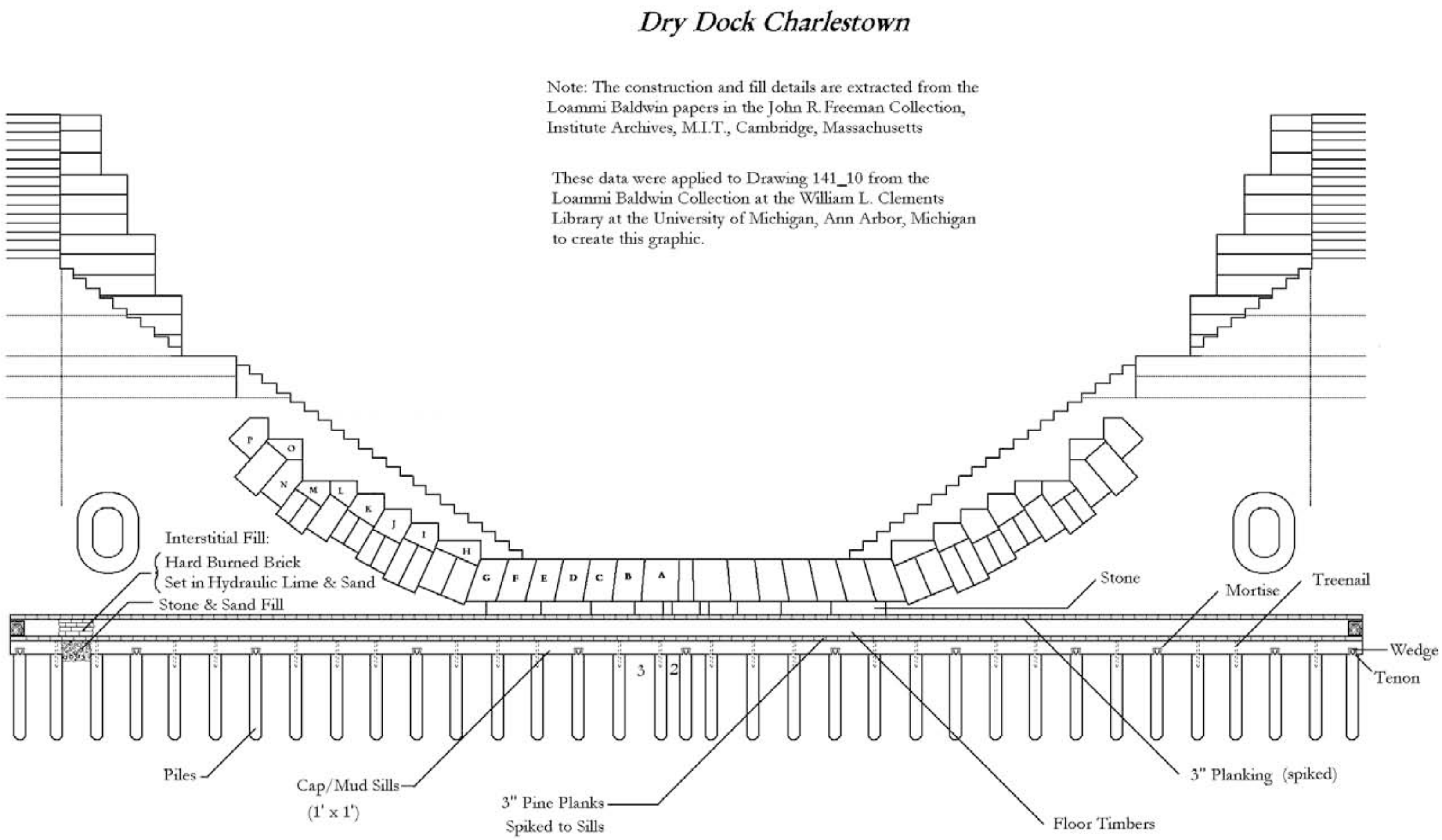


Fig. C21 Section through chamber of dry dock showing timber pile foundation and fill details. Drawing executed by Robert Stewart in November 2005.

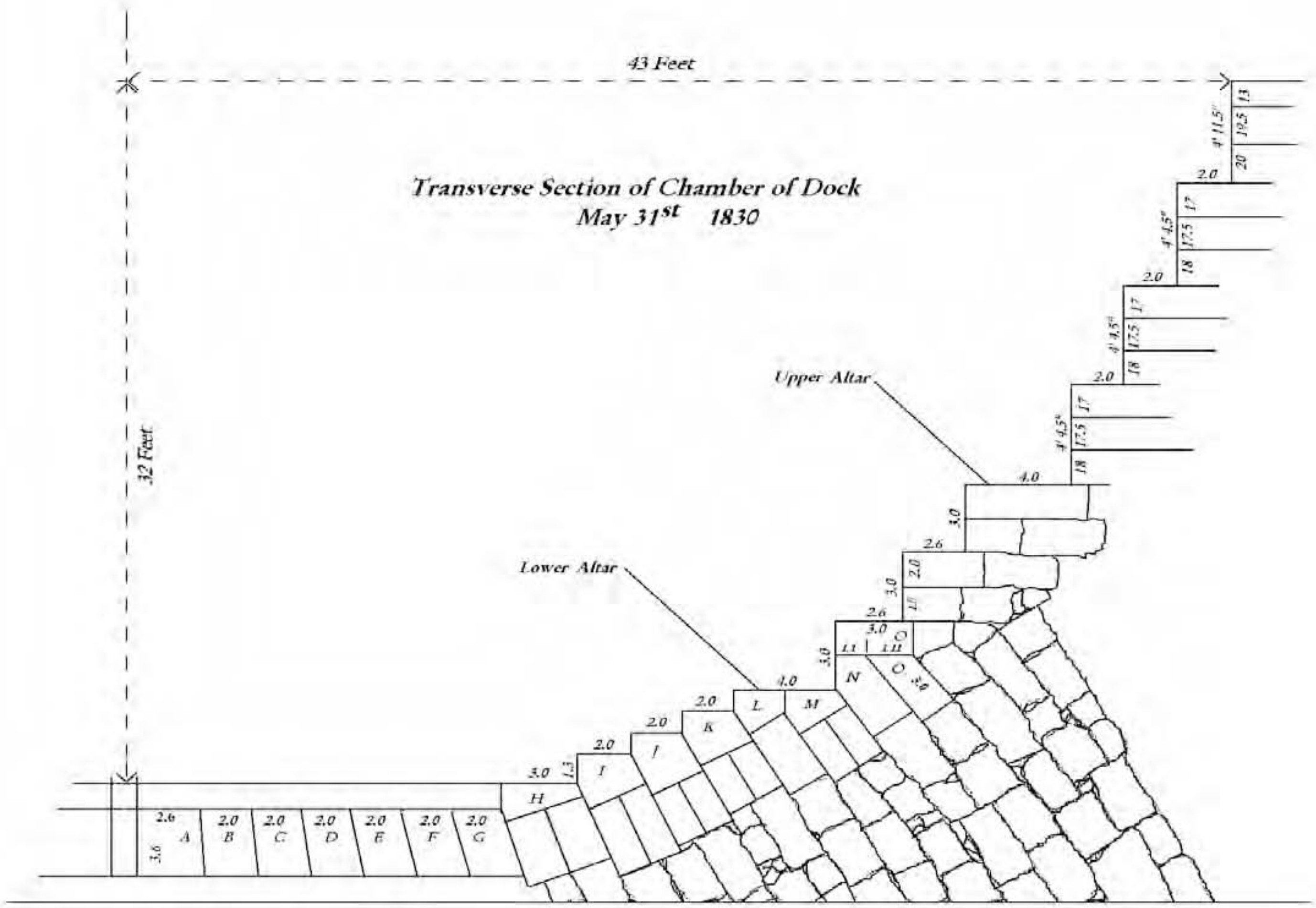


Fig. C22 "Transverse Section of Chamber of Dock," adapted from original drawing, dated May 31, 1830, by Robert Stewart in November 2005.

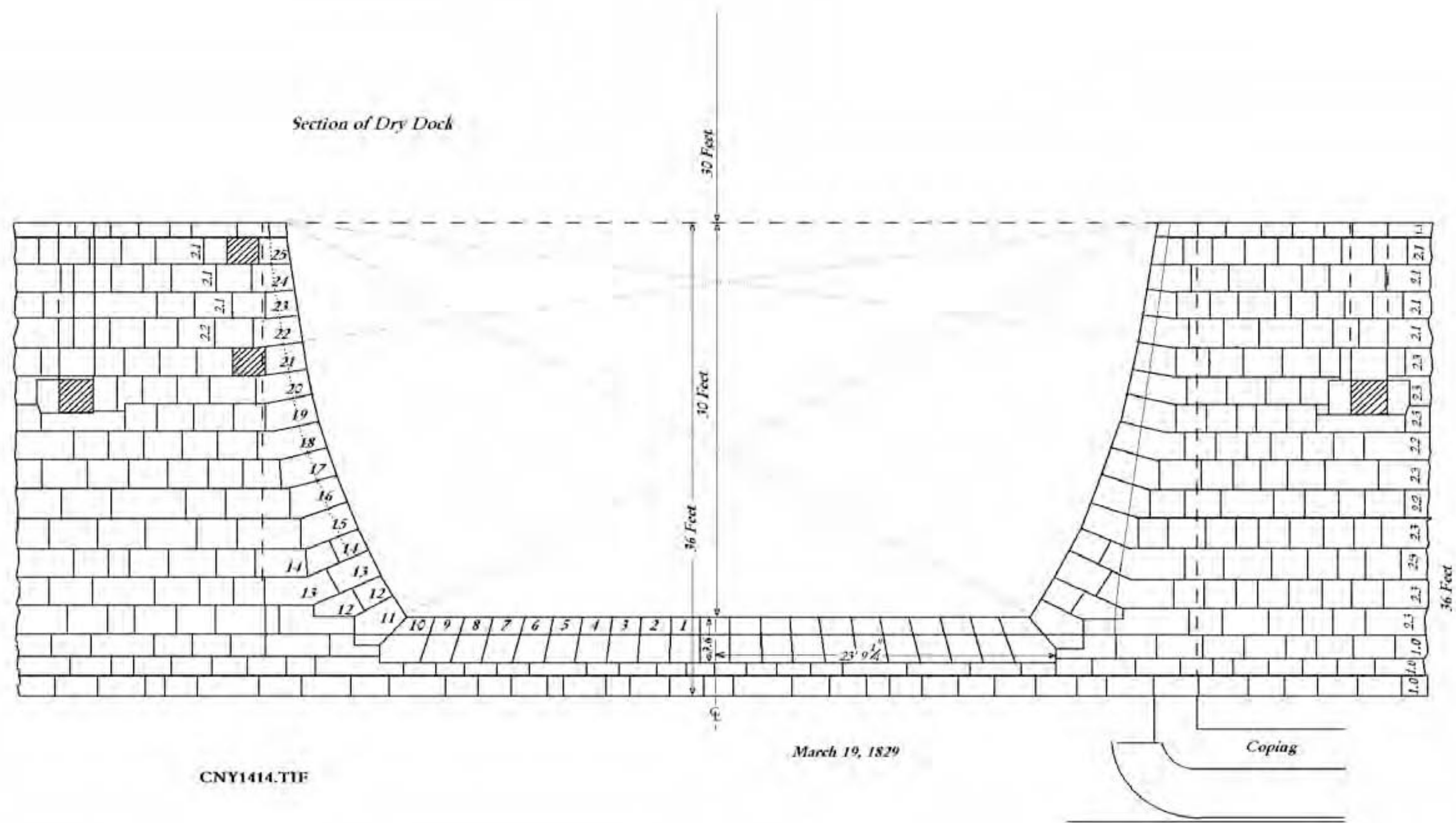


Fig. C23 Section through chamber of dry dock adapted from original drawing dated March 19, 1829, by Robert Stewart, November 2005.

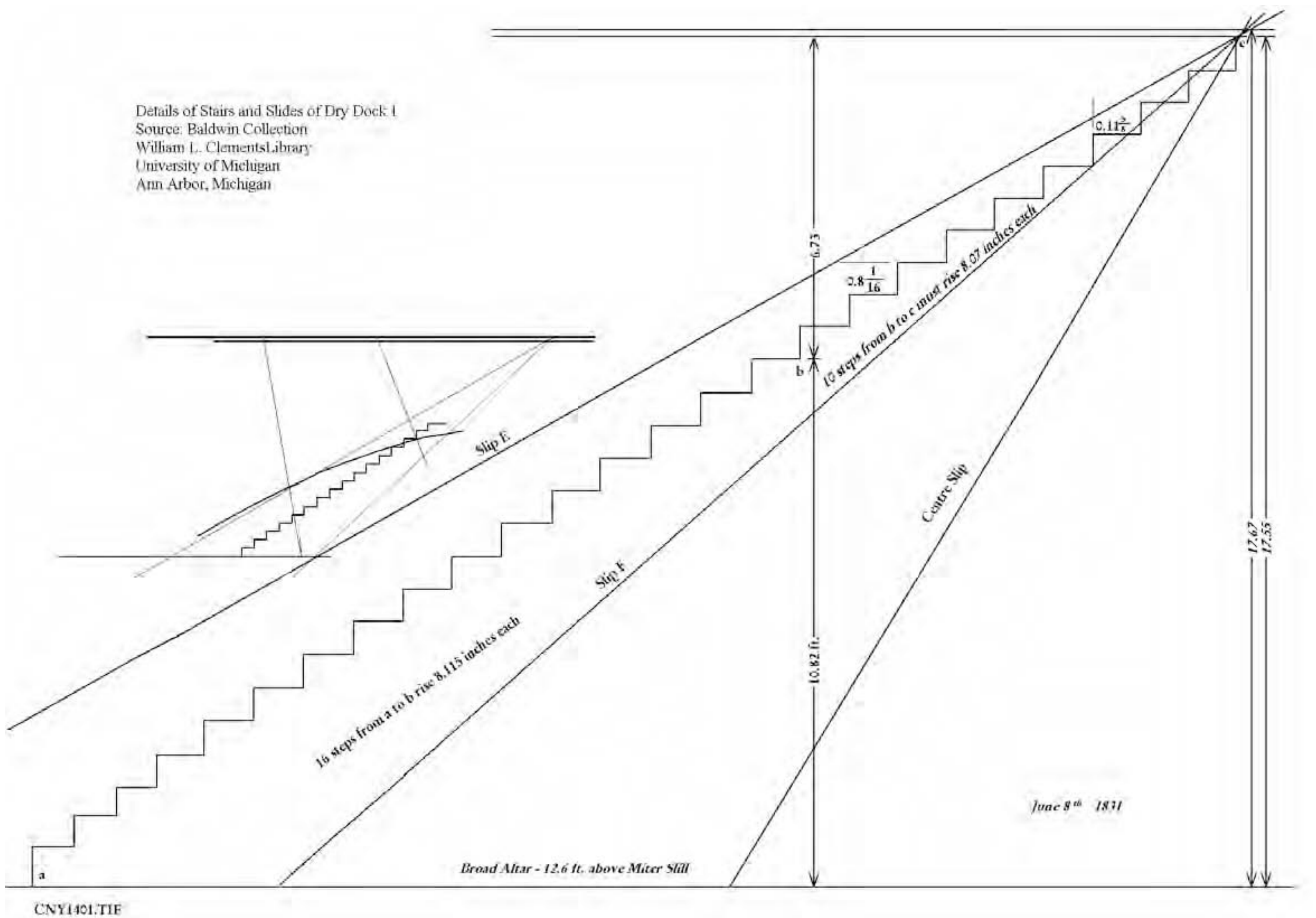
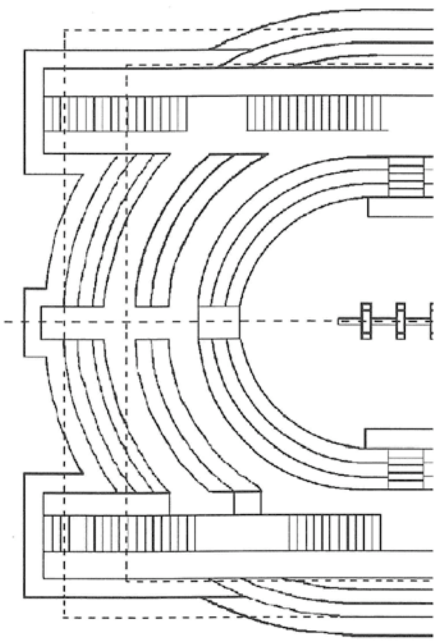
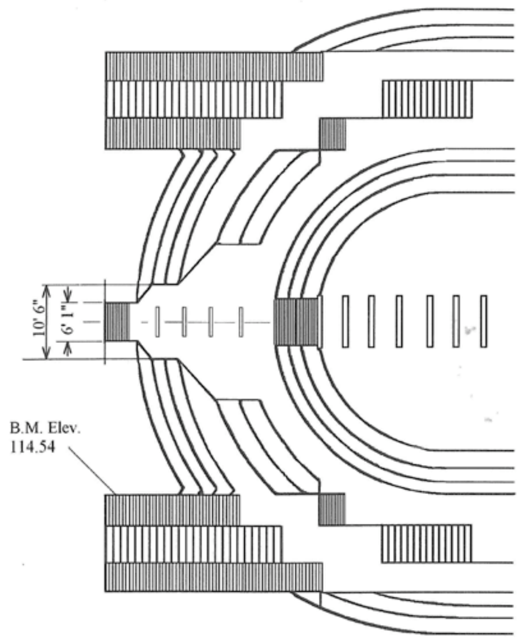


Fig. C24 Details of stairs and slides adapted from original drawings of Dry Dock 1 at the William L. Clements Library, University of Michigan, by Robert Stewart, November 2005.

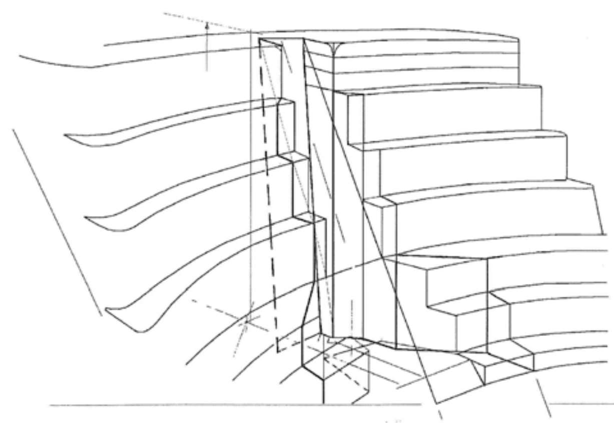
PLANS OF HEAD OF DRY DOCK 1
Comparison of Loammi Baldwin's Proposal of 1826 with Plan for Proposed Alteration dated October 17, 1940



Proposal Drawing of 1826
(See Dwg C20 for additional details)



Partial Plan of Proposed Alteration at Head of Dry Dock 1
Taken from Dwg C33



Isometric View of Head of Dry Dock 1 with Proposed Alteration

Fig. C25 Plans and isometric drawing of head of Dry Dock 1, showing alterations to center slide and proposed alterations to stairs, adapted from original drawings by Robert Stewart.

Part III: Drawings from the Boston National Historical Park Archives

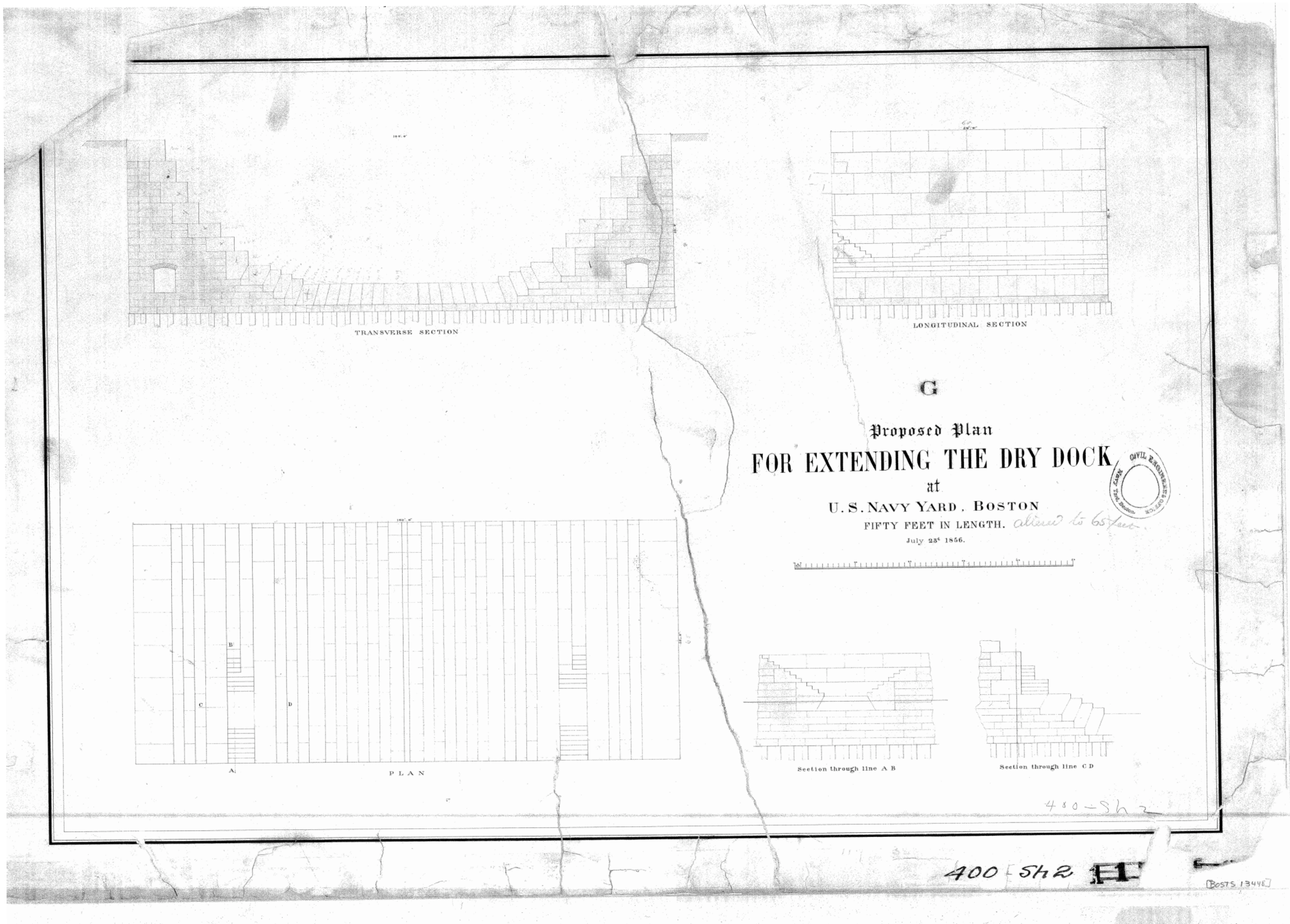


Fig. C26 "Proposed Plan for Extending the Dry Dock," July 23, 1856. CNY 400 Sh.2, BOSTS 13448.

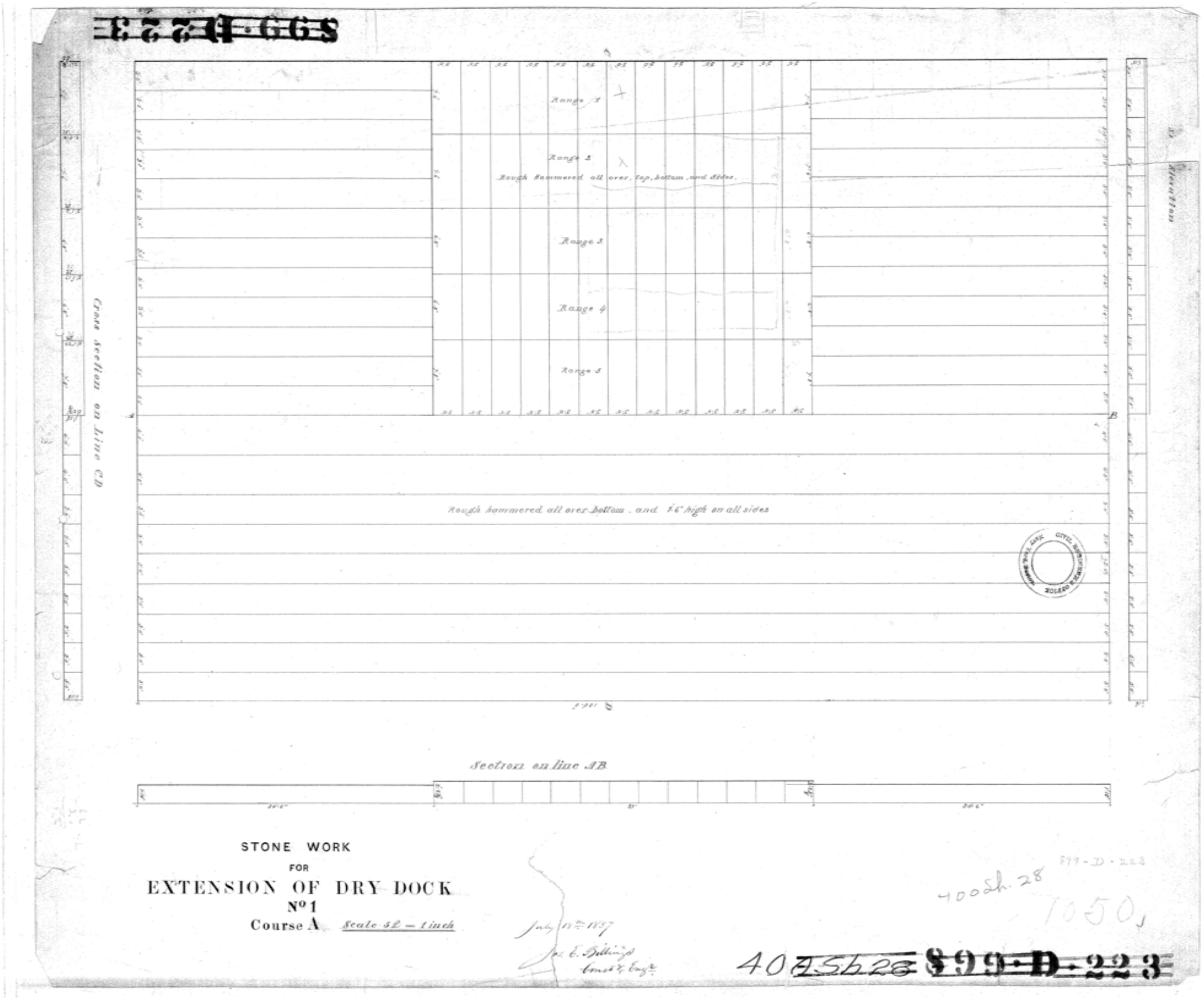


Fig. C27 "Stone Work for Extension of Dry Dock No. 1 Course A," July 18, 1857. CNY 400 Sh. 28, BOSTS 13448.

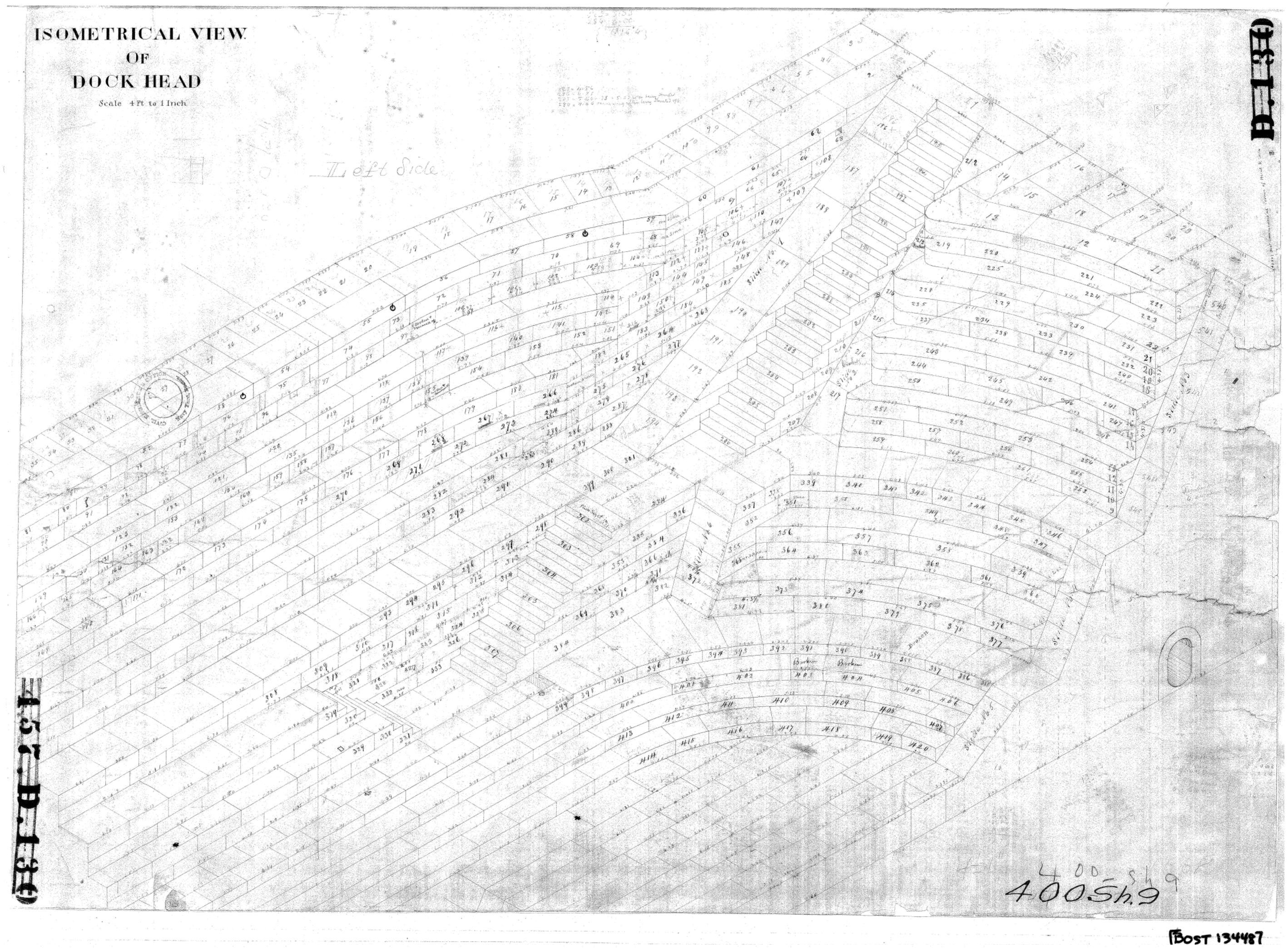


Fig. C28 "Isometrical View of Dock Head – Left Side." (No date) CNY 400 Sh. 9, BOSTS 13448.

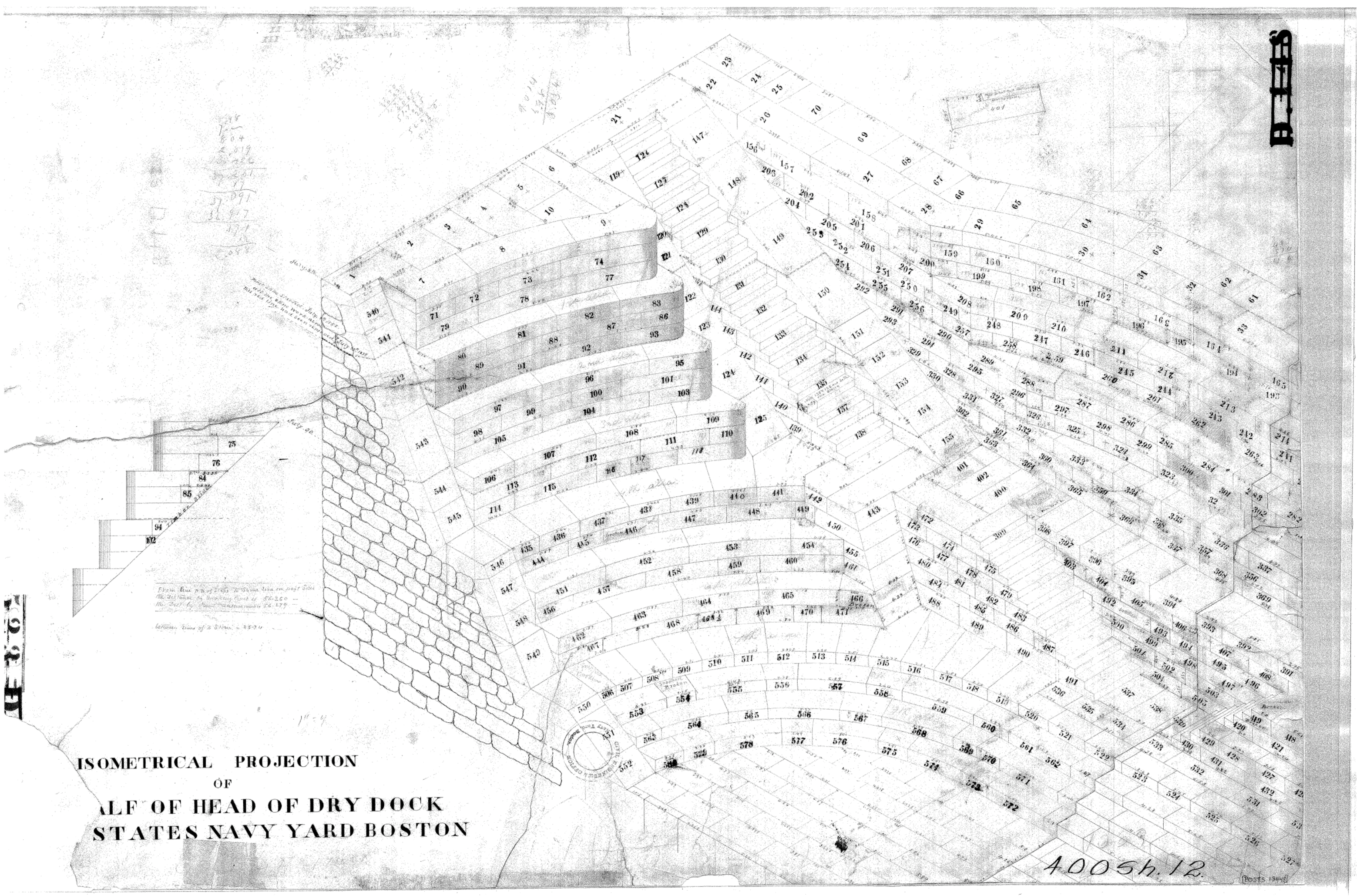


Fig. C29 "Isometrical Projection of Half of Head of Dry Dock, United States Navy Yard Boston. (No date) CNY 400 Sh. 12, BOSTS 13448.

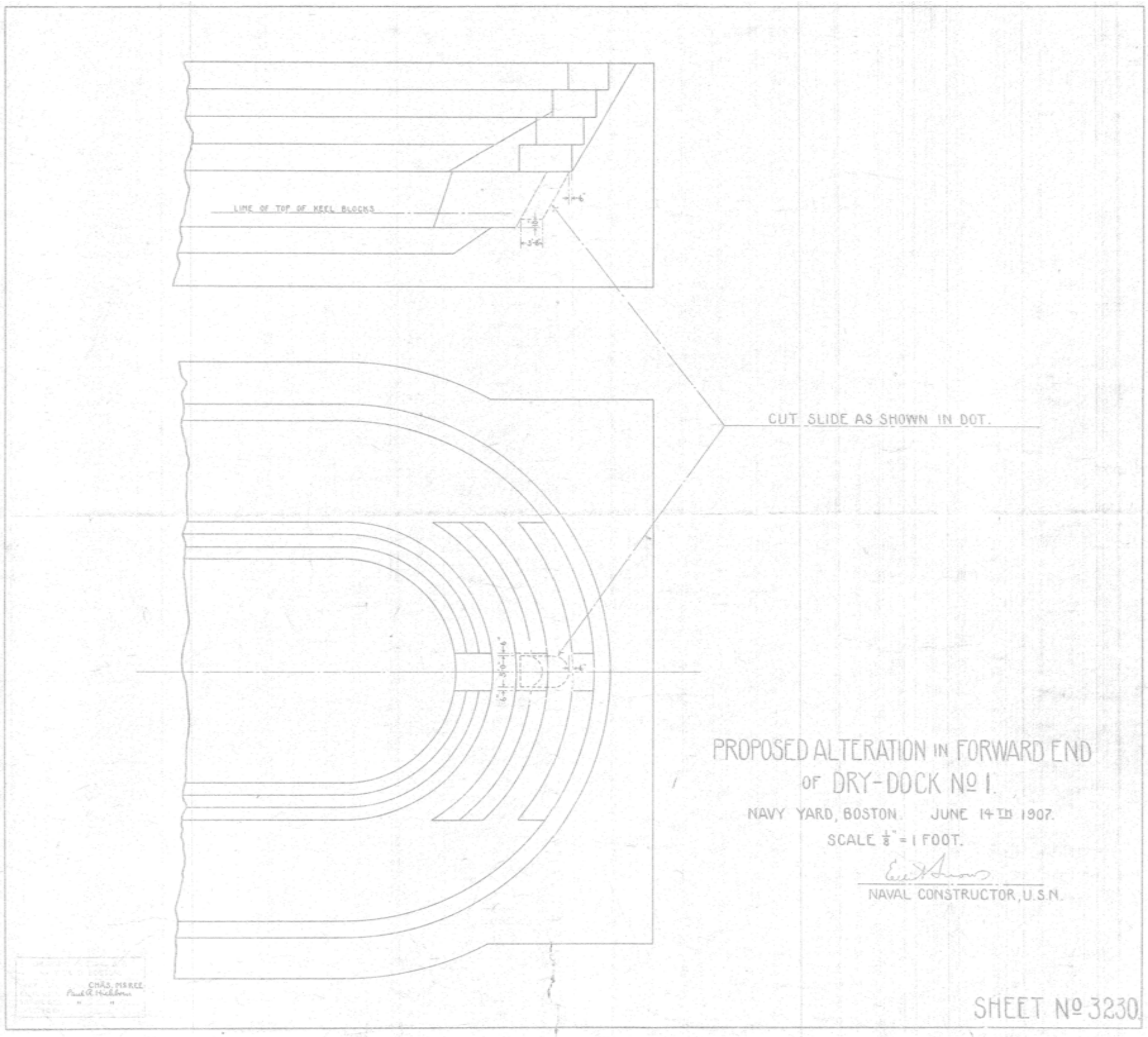


Fig. C30 "Proposed Alteration in Forward End of Dry-Dock No. 1, June 14, 1907." CNY400 Sh. 55, BOSTS 13448.

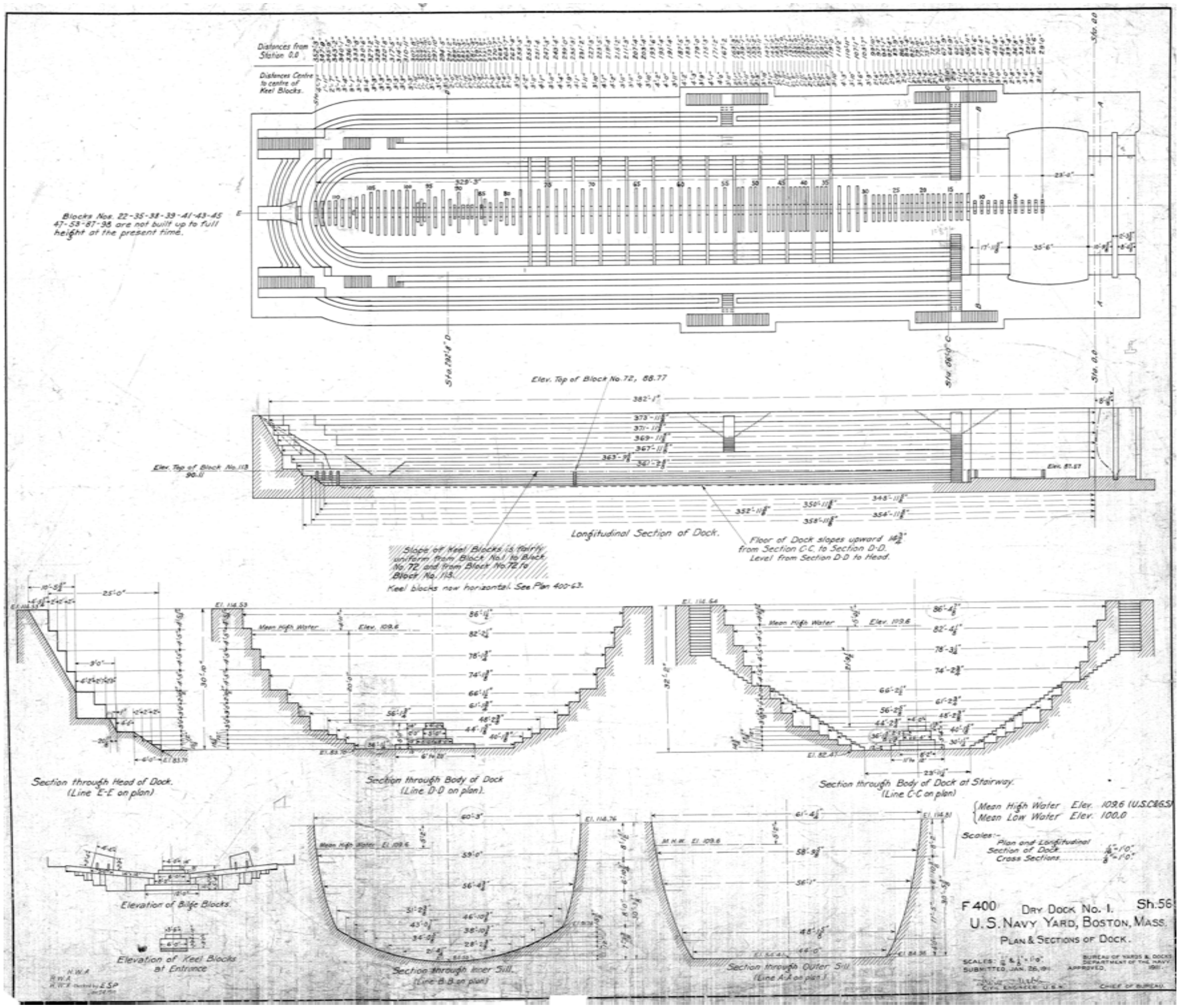


Fig. C31 "Plan & Sections of Dock," January 26, 1911. CNY 400 Sh. 56, BOSTS 13448

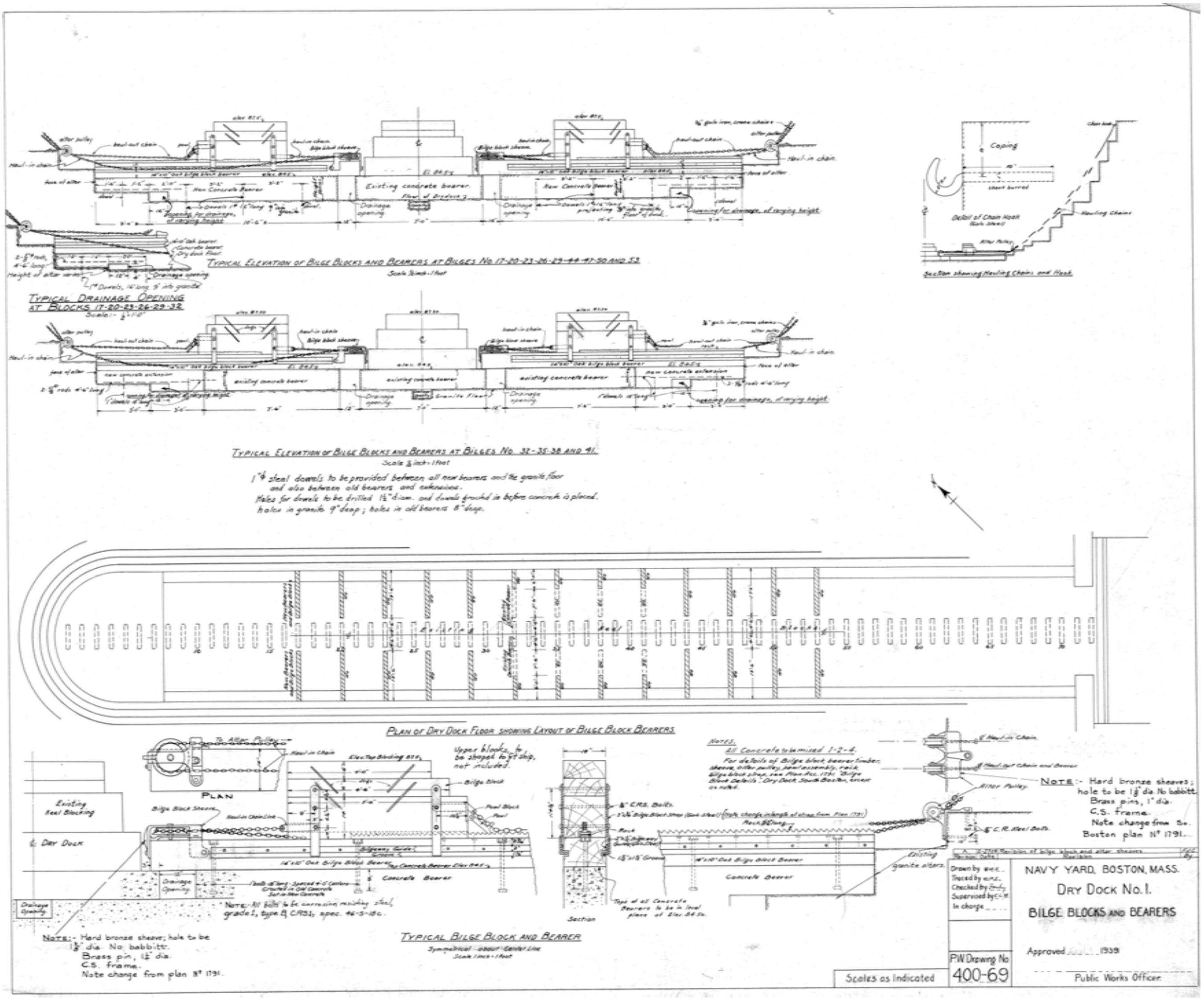


Fig. C32 “Bilge Blocks and Bearers,” February 27, 1939. CNY 400 Sh. 69, BOSTS 13448.

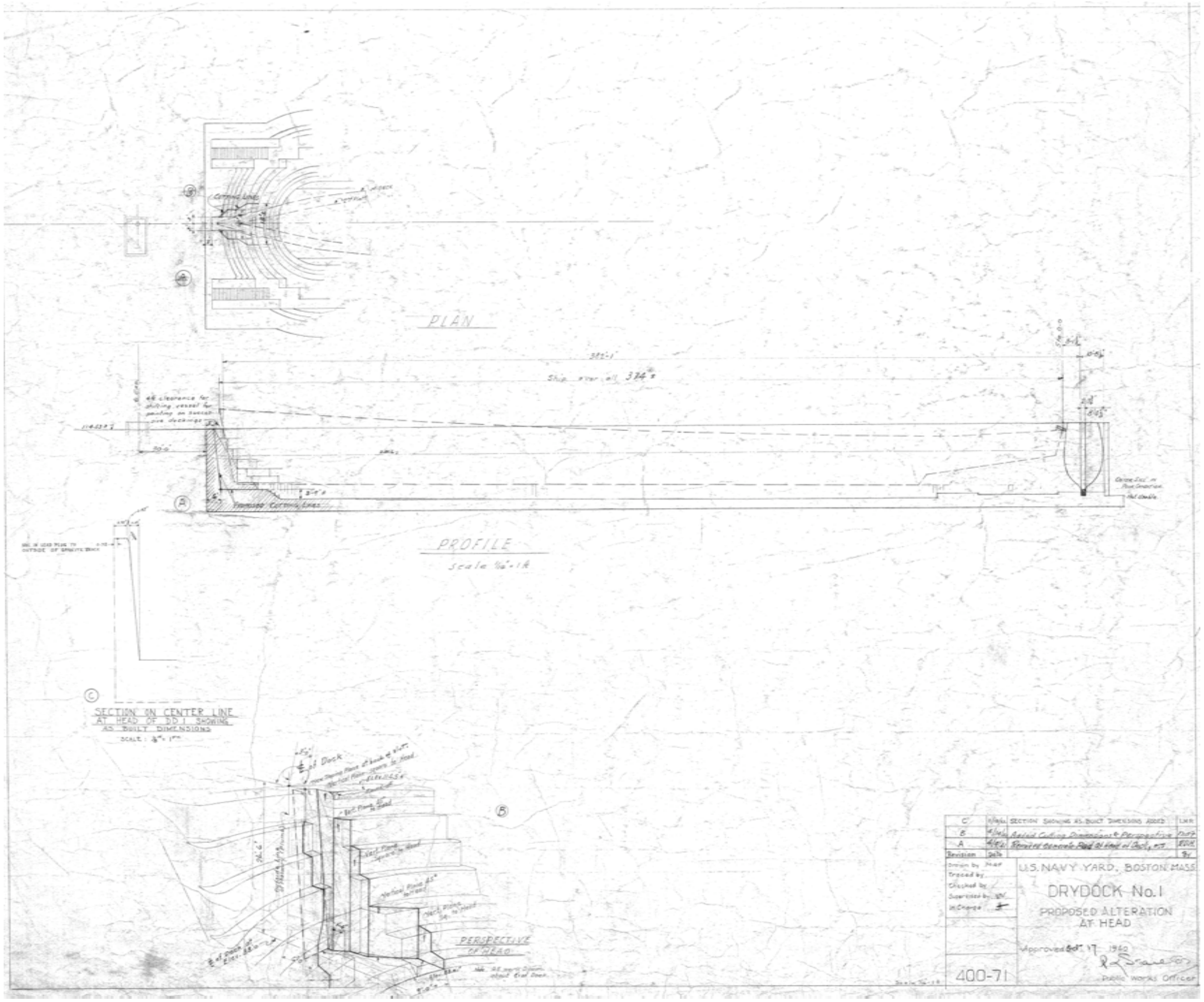


Fig. C33 "Proposed Alteration at Head," October 17, 1940. CNY 400 Sh. 71, BOSTS 13448.

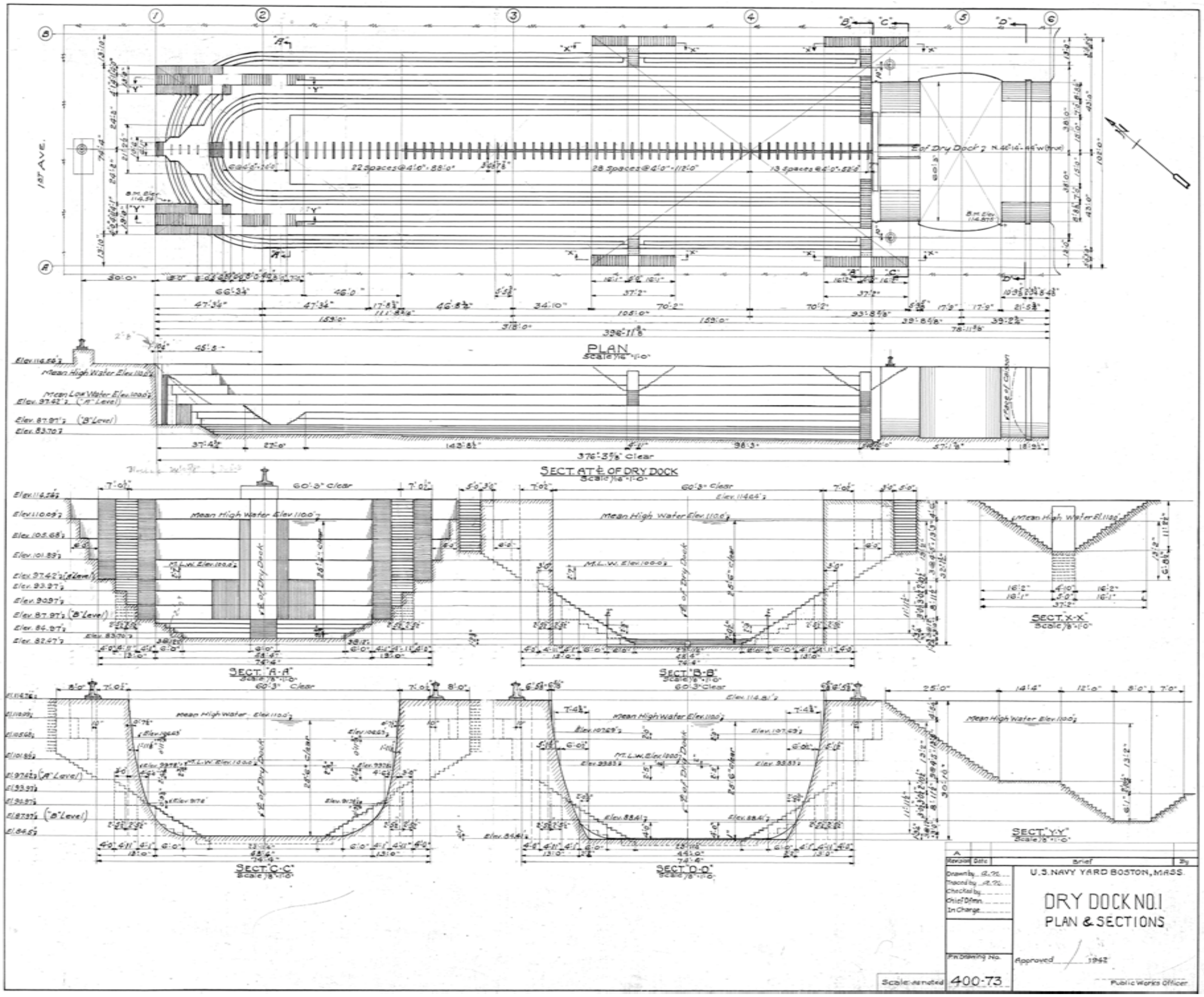


Fig. C34 "Dry Dock No. 1 – Plan & Sections," 1942. CNY 400 Sh. 73, BOSTS 13448.

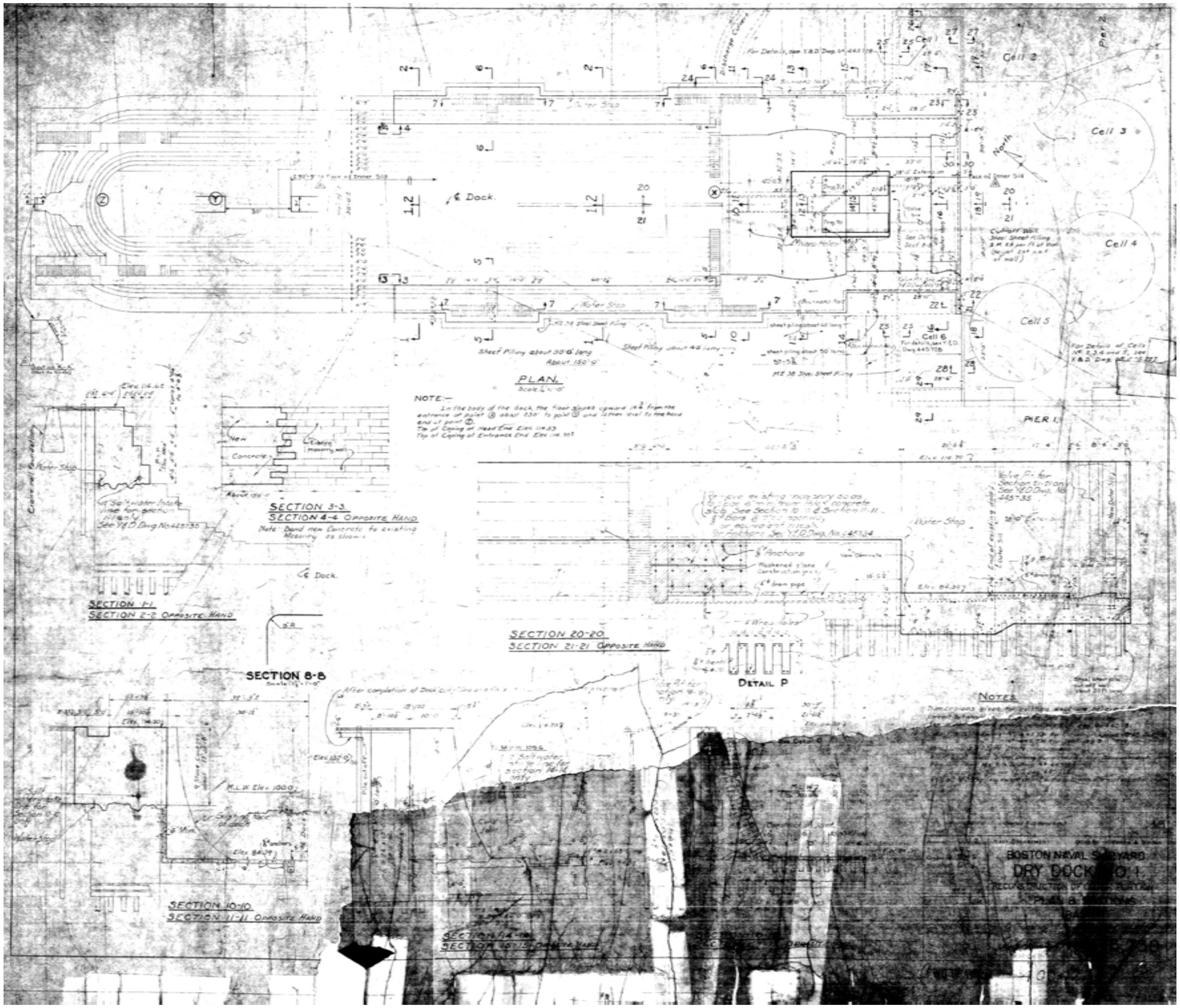


Fig. C35 "Reconstruction of Outer Portion – Plan & Sections," (No date legible). CNY 400 Sh. 122, BOSTS 13448.

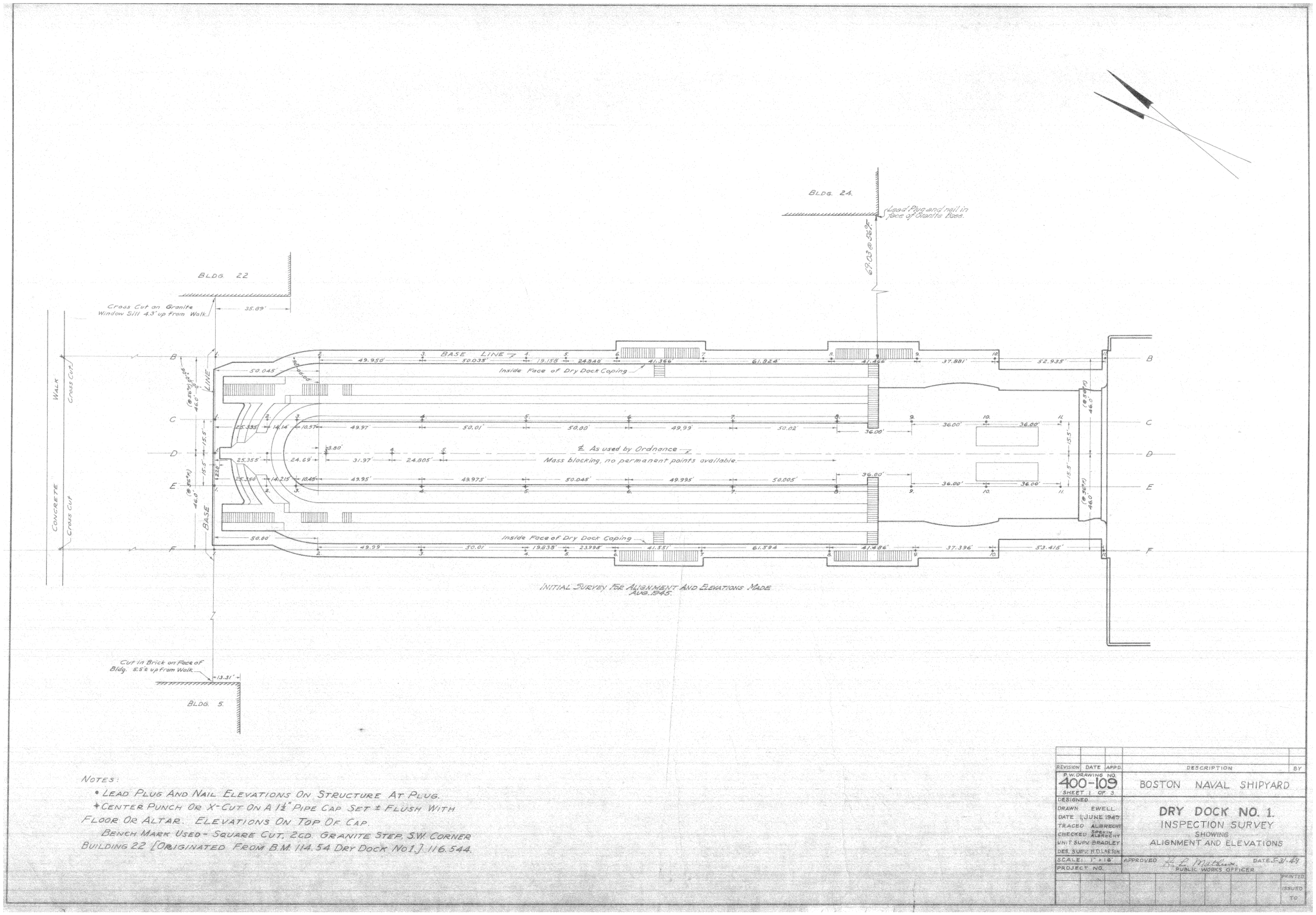


Fig. C36 "Inspection Survey showing Alignment and Elevations," May 31, 1949. CNY 400-109 Sheet 1 of 3, BOSTS 13448.

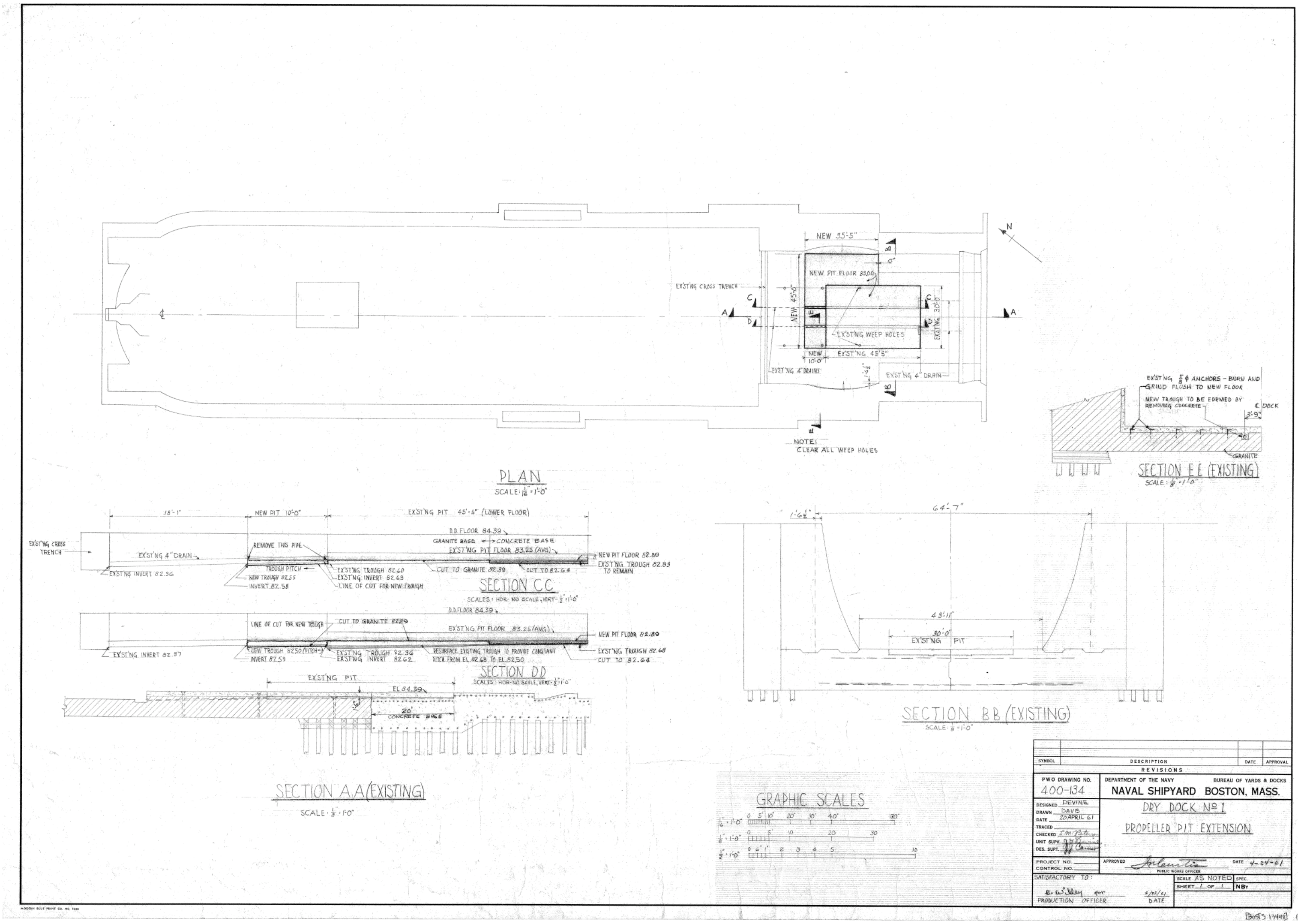


Fig. C37 "Propeller Pit Extension," April 24, 1961. CNY 400-134, BOSTS 13448.

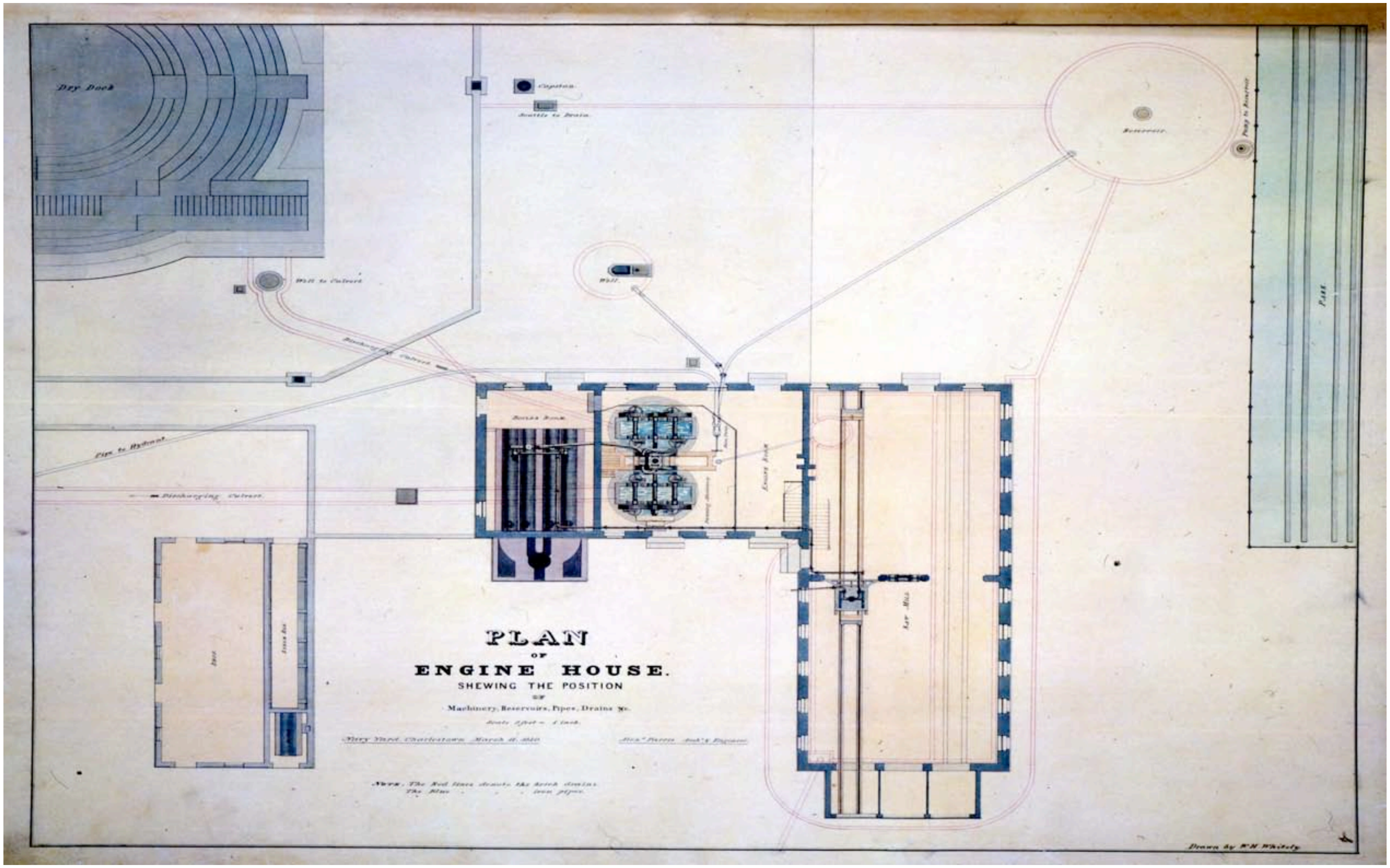
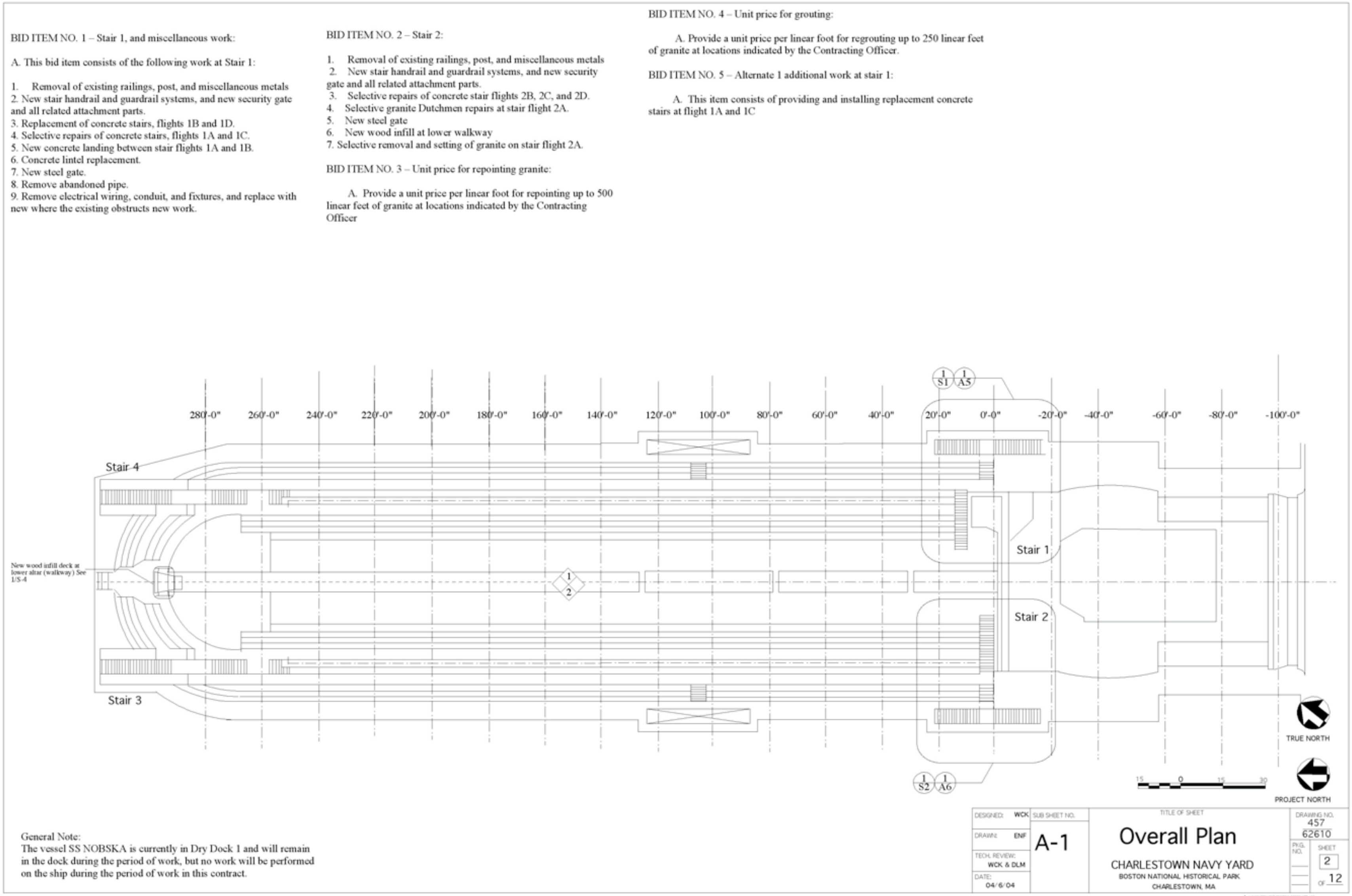
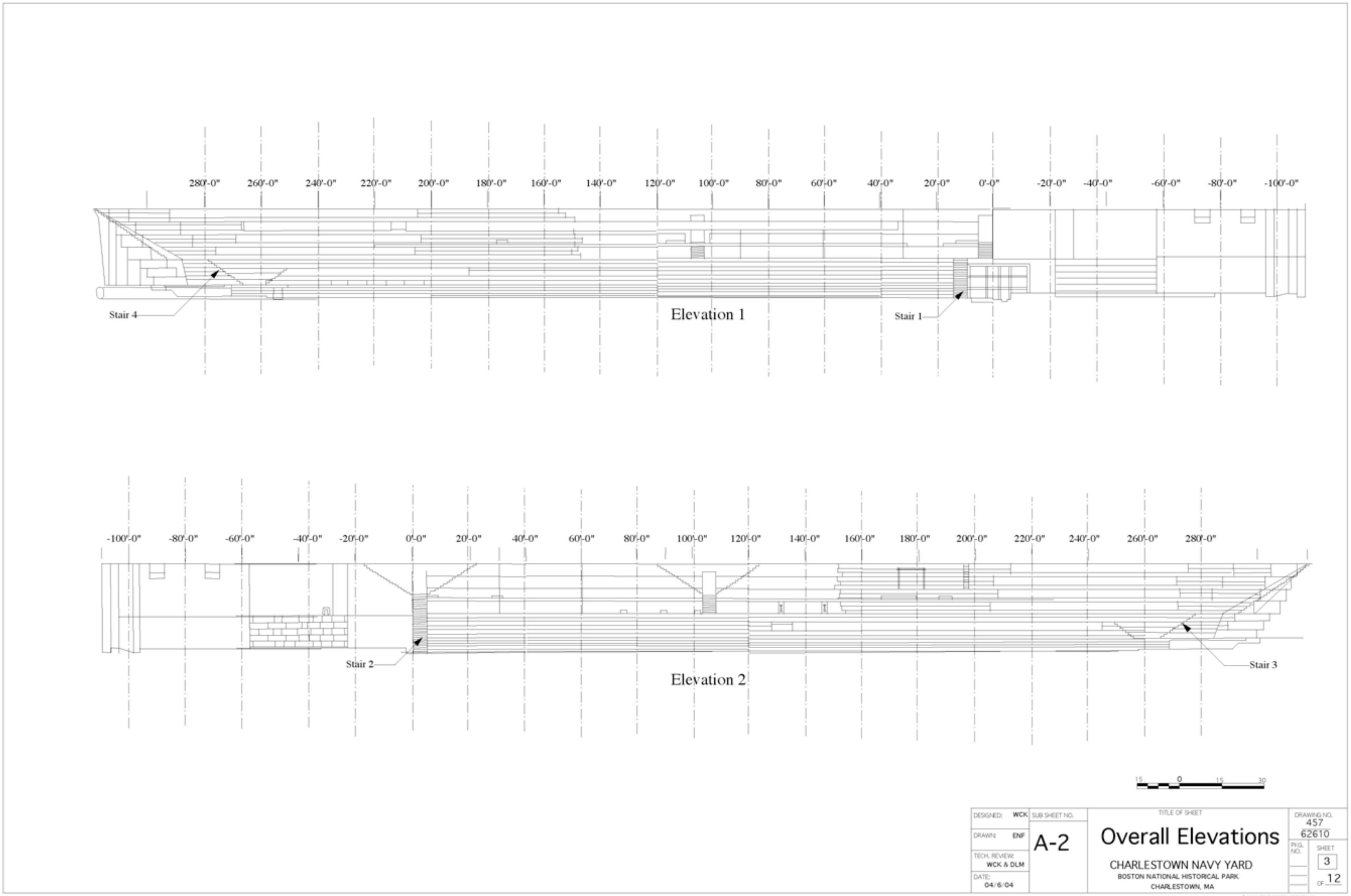


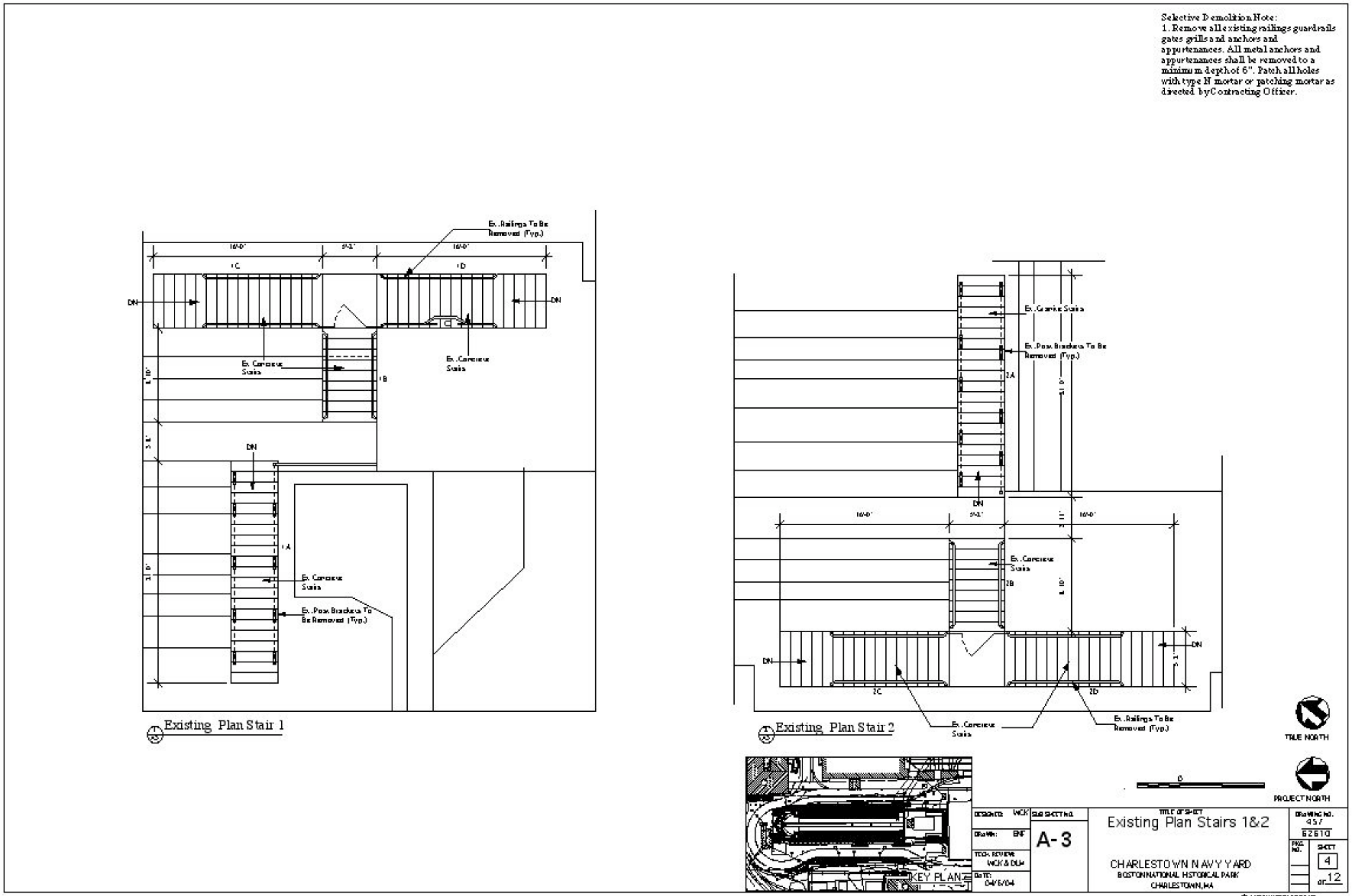
Fig. C38 "Plan of Engine House Shewing (sic) the Position of Machinery, Reservoirs, Pipes, Drains & c.," March 11, 1840.

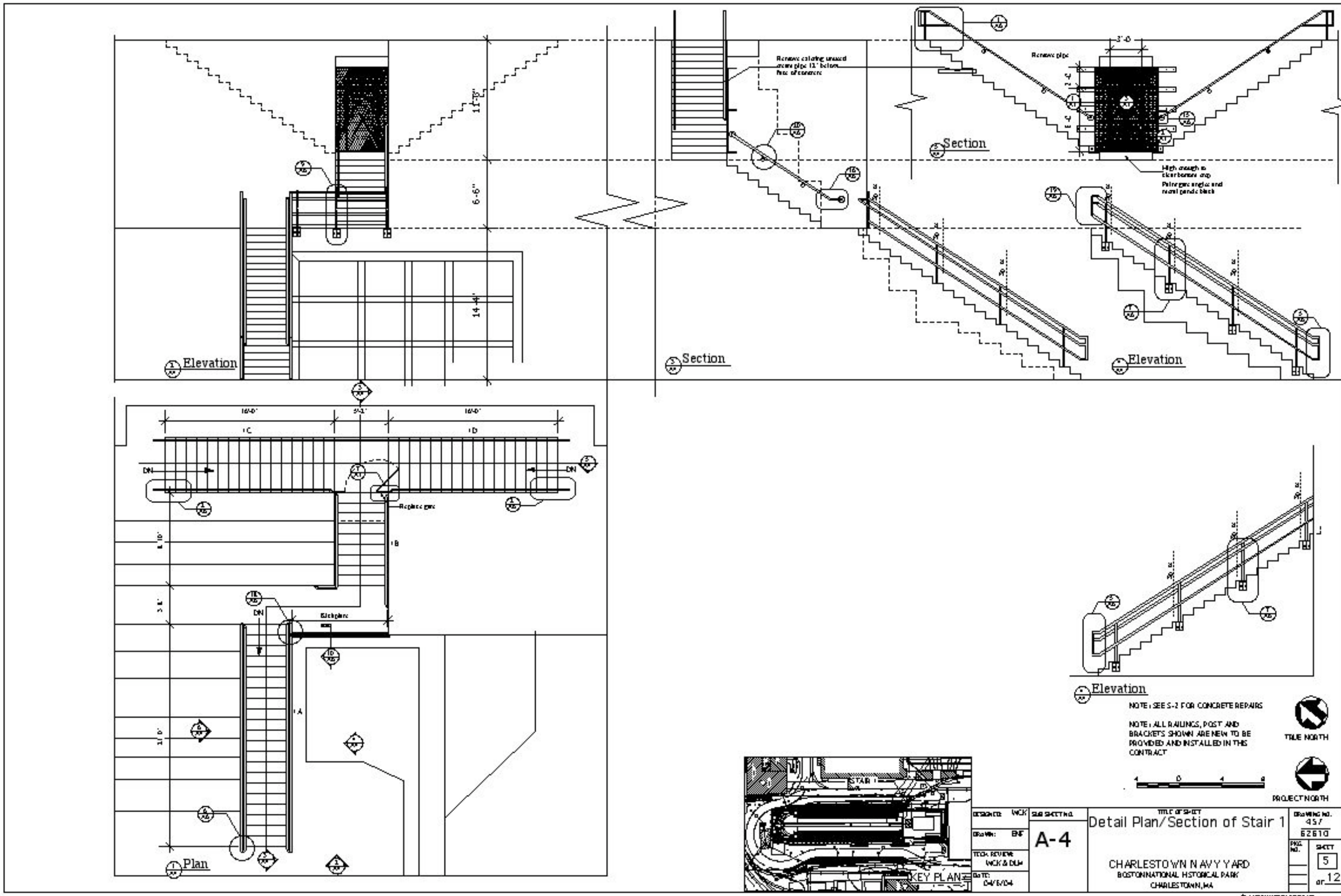
Appendix D | Stair Repair Drawings

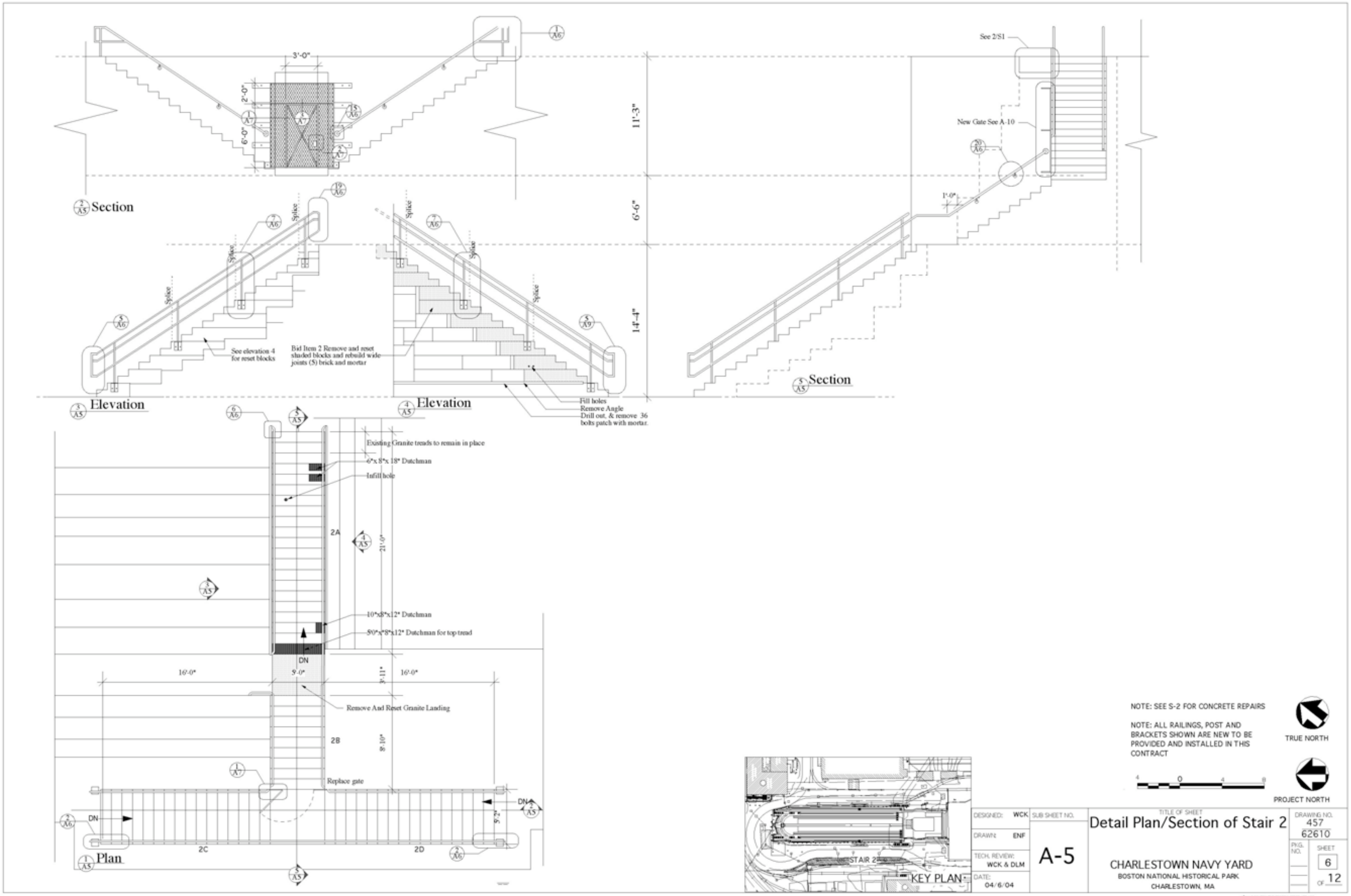


Note: Only Drawings 1-7 are relevant to this HSR and are contained herein. A complete set of drawings is located at the Boston National Historical Park at the Charlestown Navy Yard.

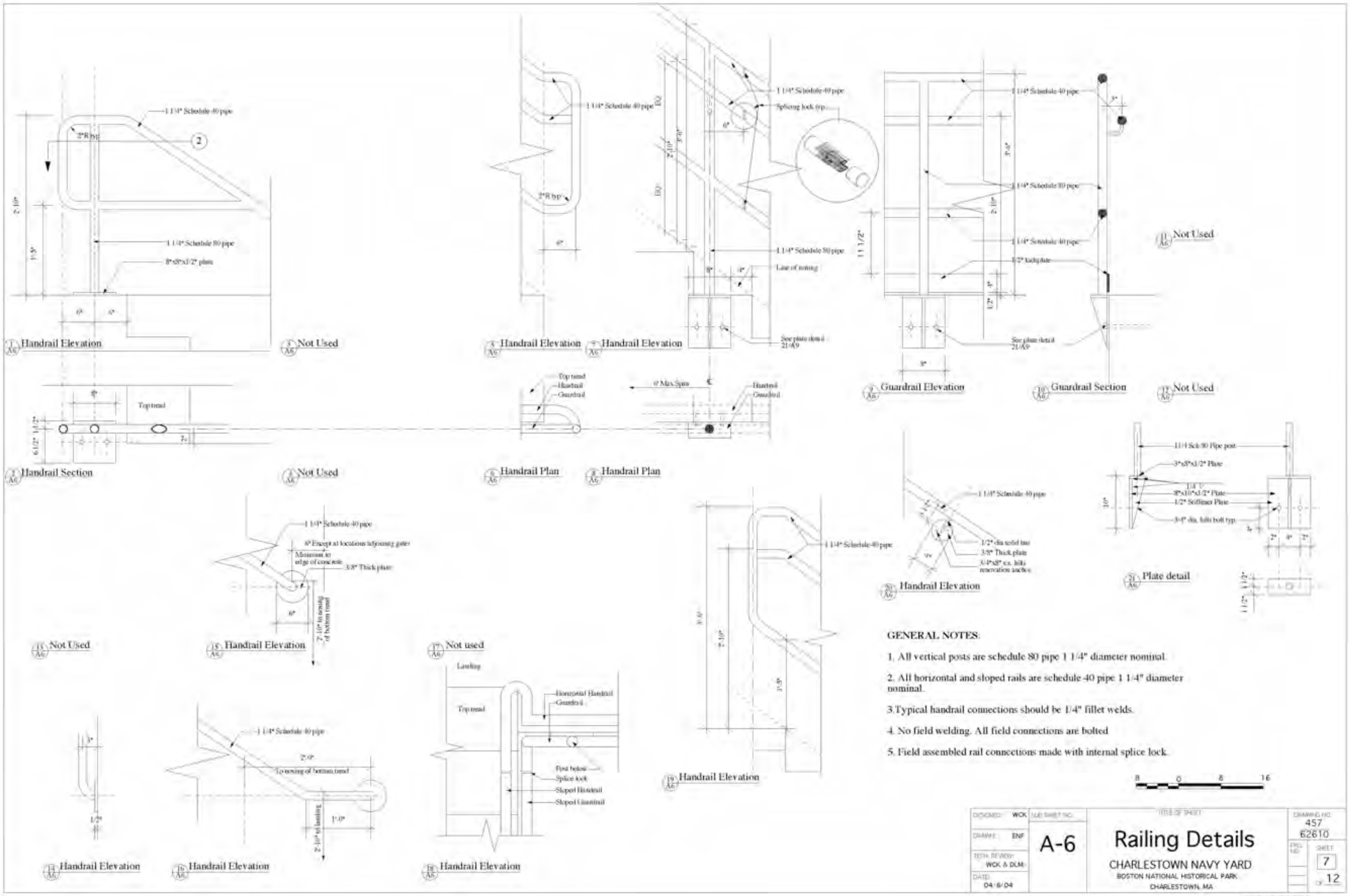

280'-0"
260'-0"
240'-0"
220'-0"
200'-0"
180'-0"
160'-0"
140'-0"
120'-0"
100'-0"
80'-0"
60'-0"
40'-0"
20'-0"
0'-0"
-20'-0"
-40'-0"
-60'-0"
-80'-0"
-100'-0"
Stair 4
Elevation 1
Stair 1
-100'-0"
-80'-0"
-60'-0"
-40'-0"
-20'-0"
0'-0"
20'-0"
40'-0"
60'-0"
80'-0"
100'-0"
120'-0"
140'-0"
160'-0"
180'-0"
200'-0"
220'-0"
240'-0"
260'-0"
280'-0"
Stair 2
Elevation 2
Stair 3
15
0
15
30
DESIGNED: WCK
DRAWN: ENF
TECH. REVIEW: WCK & DLM
DATE: 04/6/04
SUB SHEET NO.
A-2
TITLE OF SHEET
Overall Elevations
CHARLESTOWN NAVY YARD
BOSTON NATIONAL HISTORICAL PARK
CHARLESTOWN, MA
DRAWING NO.
457
62610
PKG. NO.
SHEET
3
OF 12


Selective Demolition Note:
1. Remove all existing railings guardrails gates grills and anchors and appurtenances. All metal anchors and appurtenances shall be removed to a minimum depth of 6". Patch all holes with type N mortar or patching mortar as directed by Contracting Officer.
Ex. Railings To Be Removed (Typ.)
Ex. Concrete Stairs
Ex. Post Brackets To Be Removed (Typ.)
Ex. Granite Stairs
DN
Existing Plan Stair 1
Existing Plan Stair 2
TRUE NORTH
PROJECT NORTH
KEY PLAN
DESIGNED: WCK
DRAWN: ENF
TECH. REVIEW: WCK & DLM
DATE: 04/6/04
SUB SHEET NO.
A-3
TITLE OF SHEET
Existing Plan Stairs 1&2
CHARLESTOWN NAVY YARD
BOSTON NATIONAL HISTORICAL PARK
CHARLESTOWN, MA
DRAWING NO.
457
62610
PKG. NO.
SHEET
4
OF 12


Elevation
Section
Section
Elevation
Plan
Elevation
NOTE: SEE S-2 FOR CONCRETE REPAIRS
NOTE: ALL RAILINGS, POST AND BRACKETS SHOWN ARE NEW TO BE PROVIDED AND INSTALLED IN THIS CONTRACT
TRUE NORTH
PROJECT NORTH
KEY PLAN
STAIR 1
A-4
Detail Plan/Section of Stair 1
CHARLESTOWN NAVY YARD
BOSTON NATIONAL HISTORICAL PARK
CHARLESTOWN, MA
457
62610
5
of 12



Section
Elevation
Elevation
Section
Plan
See elevation 4 for reset blocks
Bid Item 2 Remove and reset shaded blocks and rebuild wide joints (5) brick and mortar
Fill holes
Remove Angle
Drill out, & remove 36 bolts patch with mortar.
Existing Granite treads to remain in place
Infill hole
Remove And Reset Granite Landing
Replace gate
New Gate See A-10
NOTE: SEE S-2 FOR CONCRETE REPAIRS
NOTE: ALL RAILINGS, POST AND BRACKETS SHOWN ARE NEW TO BE PROVIDED AND INSTALLED IN THIS CONTRACT
TRUE NORTH
PROJECT NORTH
KEY PLAN
STAIR 2
DESIGNED: WCK
DRAWN: ENF
TECH. REVIEW: WCK & DLM
DATE: 04/6/04
A-5
Detail Plan/Section of Stair 2
CHARLESTOWN NAVY YARD
BOSTON NATIONAL HISTORICAL PARK
CHARLESTOWN, MA
DRAWING NO. 457 62610
SHEET 6 OF 12


1 1/4" Schedule 40 pipe
2" R typ.
1 1/4" Schedule 80 pipe
8"x8"x1/2" plate
Handrail Elevation
Not Used
Handrail Elevation
Handrail Elevation
Splicing lock typ.
See plate detail 21/A9
Guardrail Elevation
Guardrail Section
Not Used
Not Used
Top tread
Handrail Section
Not Used
Handrail Plan
Handrail Plan
Plate detail
Not Used
Handrail Elevation
Not used
Handrail Elevation
Handrail Elevation
Handrail Elevation
Handrail Elevation
Handrail Elevation
GENERAL NOTES:
1. All vertical posts are schedule 80 pipe 1 1/4" diameter nominal.
2. All horizontal and sloped rails are schedule 40 pipe 1 1/4" diameter nominal.
3.Typical handrail connections should be 1/4" fillet welds.
4. No field welding. All field connections are bolted
5. Field assembled rail connections made with internal splice lock.
A-6
Railing Details
CHARLESTOWN NAVY YARD
BOSTON NATIONAL HISTORICAL PARK
CHARLESTOWN, MA
457
62610
7
12
04/6/04