A BRIEF HISTORY OF THE EARLY YEARS OF THE DEPARTMENT OF DOCKS OF THE CITY OF NEW YORK INCLUDING THE OUTSTANDING ENGINEERING ACHIEVEMENTS OF CHIEF ENGINEER GEORGE S. GREENE JR. AND THE CONSTRUCTION OF PIER A AT THE BATTERY

PREPARED FOR

WINGS POINT ASSOCIATES, INC.

BY

RICHARD M. CASELLA,

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Introduction

Pier A is one of the most important remaining physical links to the rich maritime history of the Port of New York. Due to its unique design, which pioneered the use of structural concrete underwater, the pier has outlived many generations of conventional piers and unquestionably stands as a monument to the early days of harbor engineering. Pier A may be one of the last remaining concrete piers of the block and bridge design still standing. Of even more importance is its national significance for its vital role in the development and operation of what many consider the world's most important port. The Port of New York has been the gateway for the people and commerce that have made America the greatest nation in the world.

Much of the responsibility for the development of the Port of New York during the latter part of the nineteenth century rested with the Department of Docks. Through state legislation, the department virtually took control of and rebuilt the entire waterfront of Manhattan. The building of the New York Dock Walls, which encircled the island with a continous bulkhead, is recognized as one of the great feats of harbor engineering. The walls have provided engineers with important information regarding the design and performance of concrete placed underwater, friction pilings, floating foundations, and retaining walls. Numerous articles on the Dock Walls appeared in American and European engineering journals between 1875 and 1900.

The operations of the Dock Department during the building of the Dock Walls and its headquarters at Pier A were directed by the Engineer-in-Chief, George S. Greene, Jr. (1837-1922). Greene was a respected civil engineer and inventor of the drifting or shifting head for engineers' transits which was universally utilized. However, it was the success of his public works projects accomplished during his 22 years at the Dock Department that established him as the leading American engineeer in dock and pier contruction. Greene's father and also his son, Carleton, were accomplished civil engineers as well, all three having served as Director of the American Society of Civil Engineers. George Greene, Sr. was one of the eight founders of that society. Carleton Greene is noted for his 1917 treatise, Wharves and Piers. The book drew heavily on the theories and practices proven by his father, and was quickly acclaimed as the engineering textbook on the subject.

New York Department of Docks

Pier A is located on the southern tip of Manhattan, known as the Battery. The earliest known dock was built on the site in 1654 by Daniel Litchoe, a tavern keeper. In 1660 and again in 1672, taxes were levied on merchants and shipowners for the purpose building of docks and maps and other documents indicate that several were in fact built. Maps from 1728 and 1782 drawn from actual surveys show that dozens of piers were built and rebuilt in this area and that the shoreline was moving seaward through constant filling.

Early docks were constructed of timber cribs filled with stone. If they bulkheaded the shore so that a ship could dock along-side, they were known as wharves. Piers extended out perpendicularly from shore and often consisted of the cribs spaced about twenty feet apart and bridged with wooden walkways.

As the bulkheads rotted and collapsed, new ones were built out in front and filled in behind. This process continued unchecked until 1857 when a Board of Harbor Commissioners established pierhead and bulkhead lines for the purpose of improving the efficiency and volume of marine commerce entering and exiting the city. (1) This was the first effort by the City of New York to bring some semblance of order to the haphazardly built waterfront.

In 1870, due to the demands of shipping interests for better wharves and piers, the New York Legislature established the Department of Docks, headed by five commissioners. The first Board of Commissioners consited of Wilson G. Hunt, William Wood, John T. Agnew, Hugh Smith and Richard M. Henry. The Dock Department was vested with "the exclusive charge and control of all wharf property belonging to the City, including all the wharves, piers, bulkheads, and structures thereon, and water adjacent thereto, and all the slips, basins, docks, water fronts, land under water and structures thereon." (2) Additionally, they were vested with the power to govern and regulate all the same property not owned by the

City. Their first objective was "the improvement of the waterfront of the City, and the establishment of permanent wharf accomodations for special commercial interests." (3)

> "The Department found the vast trust property thus committed to its exclusive government in a condition utterly inadequate to accommodate the immense commerce of the port, all the existing wharves, piers, and bulkheads being built of perishable materials, in a very imperfect manner; the piers being too narrow to allow vessels to load or discharge cargo at both sides thereof simultaneously, and of insufficient length to afford accommodations for large steamers engaged in European trade. In consequence of this want of accommodation several lines of steamers now occupy wharves in New Jersey, which doubtless would have come to New York had the proper provision been made for them here. The greater number of existing piers and bulkheads were found to require extensive repairs, and many of them to be wholly or partially rebuilt, their condition being such as to render them totally unfit for commercial purposes." (4)

The Department advertised that public hearings would be held for all those wishing to submit plans or suggestions for the improvement of the waterfront. Five meetings were held and seventy different plans were submitted. Upon review of all the plans and discussion among the board and the department engineers, a "Plan of Docks" was proposed which would "protect the riverfront with a permanent wall of masonry carried out from the present bulkhead line a sufficient distance to make a river street 250 feet wide on the North River and 200 feet wide on the East River."(5)

On the 15th of July 1870, Gen. George B. McClellen was appointed the first Engineer in Chief of the Dock Department. Three million dollars had been appropriated for operations and McClellen immediately proceeded with the dredging of slips and the repair of piers and bulkheads belonging to the city. (Fig. 1) Placards were posted on all private waterfront structures, parcels and permanently floating

structures giving notice that application must be made to the Department for permission to retain their use. Initially, the Department "met with much opposition in the removal of obstructions on the wharves and bulkheads and in the slips, from many who, from long occupation of public property, have supposed themselves entitled to exclusive possession." (6) Injunctions were obtained restraining the action of the Department, but by April of 1872 the courts had set all of these efforts aside.

McClellen was charged with designing the proposed bulkhead wall along 25 miles of Manhattan's waterfront. He launched a massive engineering effort which included the gathering of field data, obtaining the advice of prominent engineers in the U.S. Corps of Engineers and the studying of other great harbor works around the world such as those at Liverpool and London.

Gen. A. A. Humphrey, Chief of Engineers, U.S. Army, consulted on the location of the bulkhead and pierhead lines so they would not interfere with navigation or impede the flow of the rivers. Department survey parties were dispatched along the shore to establish the pier and bulkhead lines and elevations. This information, along with 24,350 soundings, was put onto a set of maps. Twenty-two hundred borings were done along the proposed bulkhead line to determine the depth of the mud and the characteristics of the substrata.

John D. Van Buren was an assistant engineer in the Department who was given the task of researching designs for the bulkhead walls. After Van Buren's exhustive study of one hundred and thirty different plans, McClellan concluded that "it is believed that no form of foundation and superstructure has escaped attention and examination."(7)

Gen. Q. A. Gilmore, of the U.S. Army Corps of Engineers was consulted on the selection of construction materials for the bulkhead.(8) It was decided that the walls should be constructed of beton (the French term for concrete) and masonry. The design called for large beton blocks to be cast on shore, lifted by a derrick and "laid up" underwater by divers in the same manner that a stone masonry wall would be constructed. The cost of the bulkhead was estimated at 2.5 million dollars per mile. (9)

In September of 1871, the New York State Legislature officially conveyed ownership of all the submerged land bordering Manhattan Island to the City of New York. This cleared the way for the construction of the new river walls. The great derrick that would place the huge concrete blocks was completed, yards for the fabrication of the beton blocks were cleared, contracts for the supply of cement and stone were signed and construction began. (Fig. 2) In 1874, Van Buren presented a paper before the American Society of Civil Engineers (ASCE) describing the manufacture of the beton blocks and the bulkheads. He stated that "the idea of using large beton blocks for this work is due, I believe, entirely to Gen. McClellen, and the late operations of the department show that the plan is an exceedingly expeditious and cheap one." (10)

The bulkhead project was an early use of concrete underwater in the United States on a large scale and engineers watched the new technology closely. The economic and scientific soundness of McClellen's methods was further reinforced by Hamilton Schuyler's paper on the the subject presented in May 1875 before the ASCE. Schuyler worked for the Department of Docks and supervised the construction of 9293 cubic yards of beton blocks by manual labor between 1873 and 1874. Blocks ranged in size from 13 to 60 tons and were found to be economically and easily produced by manual labor. A detailed discussion of the methods, materials, material suppliers and labor employed is given in Schuyler's paper. Extensive testing was performed to determine crushing strengths depending on various conditions underwhich the blocks were made and cured. Schuyler observed that "nothing can be cheaper or better for the abutments of bridges, for the bases of piers and the like than beton blocks..."(11), and "the making of the blocks was part of a system for the bulkhead wall that was, after full consultation with General Q.A. Gillmore, inaugurated by General George B. McClellen. " (12)

However, in 1873 Gen. McClellen resigned from the Department and a Gen. Charles K. Graham took over as Chief Engineer. (13) While Gen. Graham continued to use the pre-cast blocks, he also implemented a new and unperfected method of placing concrete underwater known then as concrete-en-masse. This technique is known today as cast-in-place and

when used underwater entails sinking a form into which wet concrete is poured or dumped and allowed to harden into a single mass. Exactly why Gen. Graham was compelled to try to further improve a method which was already a vast improvement over previous technology is unclear. According to Van Buren, the en-masse method was instituted "on the ground of economy". (14) Graham gives a defence of his decision in his report to the Dock Commissioners in 1875 and describes in detail his study of the technique as it was being used in Europe by French and British engineers. (15)

Structural concrete underwater by any means was still a new practice in Europe and the United States. Its use as a foundation material for massive and expensive civil works projects like breakwaters and other harbor works was still in its infancy. In 1856, W.R. Kinipple, a British civil engineer, began experimenting with portland cement concrete placed underwater. Kinipple designed and directed numerous projects including major harbor works in England and Canada and claims to have originated most methods of utilizing concrete underwater including concrete-en-masse, precast blocks, tremmie pours, and slip-form casting. However, it was not until 1886 that he presented a paper to the Institute of Civil Engineers in London describing the results of his 30 years of experience and the problems he had encountered with en-masse concrete underwater. (16) By that time, most of his lessons had already been learned the hard way by the Dock Department.

Structural failures in Graham's en-masse type dock walls appeared within a year or two. (Fig. 3) This resulted in an investigation in 1875 by a special commission of three esteemed engineers: General John Newton, Gen. Q. A. Gillmore, and William E. Worthen, Past President of the ASCE. At this same time, George S. Greene, Jr. was appointed the new Engineer in Chief of the Department of Docks. He took immediate charge of the work and instituted his own investigation of the problems by having a diver inspect the bulkheads underwater.

In conjunction with Greene, the commission performed an experiment to test and analyze the structural integrity of en-masse concrete in seawater. A duplicate of the wooden formwork used to cast the walls was built and specially reinforced to be lifted out of the water by the derrick. The form was lowered underwater and filled with concrete-en-masse as if it was to be a permanent section of wall. One month after the pour, the block was removed from the water by the derrick, the formwork removed, and inspection and testing performed. The results of the investigation confirmed the failures in the concrete that were being observed in the field: the methods in which the concrete was deposited underwater resulted in a separation of the cement and aggregate, the latter often falling to the bottom of the pour; the outer layers of the block were the weakest, with large sections of the concrete falling away as the forms were removed; the bond between each batch or pour was weak or non-existant resulting in a seam, along which structural failure would occur. In the commission's report, Gen. Gillmore explained the likely mechanical and chemical mechanisms behind the problems and made recommendations for new procedures and techniques to be followed in building the dockwalls. First, depositing concrete en-masse underwater should be limited to sub-bottom placement or for "hearting" (filling the core of the bulkhead to consolidate the blocks and masonry into a single mass), where it will not come in direct contact with wave action. Second, deposition of the wet concrete underwater should be done with a tremie rather than a bottom dump bucket. A tremie is basically a

funnel attached to a long pipe which reaches the bottom where the concrete is being placed. The concrete is poured into the funnel at the surface and the pipe is kept continually submerged in the "pour" to eliminate mixing of the concrete and seawater. (17)

Mr. Greene implemented these recommendations and further improved on the effectiveness of the pre-cast block system developed by McClellen. Greene devised several different bulkhead systems for the varying sub-surface conditions found along New York's waterfront. At the heart of each of these designs was an improved block which was not only large in size (70 tons), but batired or sloped on its face to accomodate the curvature of ship hulls. This design allowed the center of gravity of the wall to be set back from the toe of the wall, thus increasing the resistance of the wall to overturning. (Fig. 4) In areas where bedrock was close to the surface, the wall was founded directly on the rock, with concrete in bags used to level the surface. In areas where the mud was very deep and bedrock essentially out of reach, the wall was founded on pilings driven to a given resistance. This was determined by the number of blows of a certain weight pile-driving hammer needed to drive the pile another inch or foot. (Fig. 5) The resisting force is a result of the friction between the piling and the mud or clay, hence the name "friction piles". Several sources credit Greene with essentially proving the validity of the engineering principles behind friction piles. (18) It is likely that Greene was the first to design and implement a gravity retaining wall supported by friction piles constituting what became known as a "floating foundation." In the following years Greene continued to improve his designs for the river walls and another cross section is presented in Fig. 6.

In September of 1881, the Commissioners of the Department of Docks requested Newton, Gillmore and Worthen to once again evaluate the construction of the river walls, this time as designed by Greene. After three months of extensive observations, measurements and testing, they presented their report on the 27th of December, 1881.(19) Their findings included a detailed discussion of the merits of the overall design, particularly its unique character of being essentially a "floating foundation," a design in which "slight

movement is inherent, and yet in no way destabilizing or worthy of concern." (20) Their only recommendation was that the concrete mix was too rich in portland cement, and yielded a block that posessed excessive strength and durability to a degree that was unnecessary. In conclusion they found "the present cross-section of the wall, as designed by your Engineer in Chief, we regard as founded on correct principles of stability and economy..." (21) With this approval of Greene's designs, the building of bulkheads and piers by the Dock Department moved forward at a rapid pace. The Department grew in size and the need for a new headquarters became a priority.

Pier A, North River

It is not evident from the Annual Reports of the Dock Department when talk of building Pier A began or how its design and location were selected. The pier is located on the southern tip of Manhattan Island on the North River between Castle Garden, also known then as the Battery and now as Battery Park, and Pier 1, which is now demolished. According to a report of operations from 1872, it is evident that the earliest work of the Dock Department involved the construction of a granite bulkhead along this section of shoreline. (Fig. 7) This wharf was known as the "boat landing" and was used by the city to tie up their various floating barges and derricks for the construction of the river wall from that point north along the rivers. (22)

The first mention of the Pier A project appears in the Appendix of the 14th Annual Report of the Department of Docks for the year ending April 30, 1884. (Appendix A) It refers to the "Proposed New Pier between the Castle Garden and Pier New 1, N.R., for the use of the Police Department and the Department of Docks," and states that between November 15th to the 24th, 1883, an examination of the site for the proposed new pier was made by the boring machine "Woodcock".(23)

The following year's report (Appendix B) provided this information:

> "On the 3rd of July, 1884, it was directed by unanimous resolution of the Board to proceed with the construction of a pier for the uses of the Department and also the Police Department, in accordance with a plan submitted to the Board on that day."(24)

Twenty days later the construction of Pier A began with the Union Dredging Company excavating 4000 cubic yards of mud and rock from the pier site. When the dredger finished in early August, the underwater construction began on all the pier foundations. Work continued rapidly with the intent on finishing by January 1, 1885. Greene states in his work reports that had the furnishers of the granite delivered the stone on time as promised, this goal would have been

met. Instead the sub-piers were not completed until April of 1885. The deck was finished in September, and the building on the pier completed in March of 1886. (25)

The substructure of Pier A is a type of pier design known as block and bridge. According to Carleton Greene in his 1917 book, Wharves and Piers, there are three general types of piers: pile-platform, block-and-bridge, and solid fill. (26) Greene states that "the block and bridge model is rather limited in its application, as it is economical only for small piers in shallow water and on hard bottom." (27) Although Pier A is relatively small and built on bedrock in shallow water, it is interesting that the final square foot costs for deck and substructure of $11.60 per square foot are roughly 10 times the cost of pile-platform piers. (28) Considering life-cycle costs, that is, the initial cost plus maintenence costs over the number of years in service, Pier A proves very economical in the long run. It has outlived three pile-platform piers which due to marine borers or corrossion have estimated lives of approximately 35 years. Pier A has also remained in continuous service without any expenditure for maintenence and without a loss of income due to down time for repairs or rebuilding.

As of 1917, there were only two block and bridge piers ever built in New York, Pier 1 in 1876, and Pier A in 1885. (29) Both of these piers consisted of widely spaced (30-50′) masonry block piers bridged by a structural deck.

Pier A is 45 feet wide and 285 feet long and is supported by 8 concrete and granite piers. Each pier is 45′ wide, spaced 35′ apart and extend from 2.5′ above Mean High Water (M.H.W.) down to the bedrock, which varies in elevation from approximately -18′ to -45′ M.H.W. Each pier consists of a foundation of mass concrete in burlap bags resting on the bedrock, pre-cast concrete blocks extending to -2′ Mean Low Water (M.L.W.), and granite block on top of the concrete up 2′ above M.H.W.

Spanning each of the piers are six wrought iron I-girders and two side girders, spaced approximately eight feet apart. Between these girders is sprung a cast-in-place arched concrete deck. (30)

The construction of Pier A entailed the following steps: (31)

1. Dredging:

In each pier location the river mud was excavated down to bedrock utilizing a clamshell bucket on a floating derrick. (Fig. 1) From drawings it is evident that as much as 20 feet of mud and rock was removed to reach bedrock.

2. Pier Foundations:

Large wooden cribs, 50′ x 15′ with sides averaging five feet in height, depending on the contours of the bedrock, were lowered to the bottom and leveled using the Derrick "City of New York".(Fig.8) These cribs held back the mud and provided a container to hold bagged concrete. Divers, using powerful water jets, "blasted" any remaining mud out of the cribs to provide a clean rock surface. Between 50 and 75 c.y. of wet concrete in burlap bags was lowered to divers who piled them inside the cribs directly on the uneven rock bottom until a level surface was obtained. The cribs were then filled to the top with 30 to 60 c.y. of mass concrete deposited with a bottom dump bucket, and leveled off by divers using heavy straightedges. This consolidated the concrete bag sub-footing and provided a level and uniform surface to receive the massive precast concrete blocks. (Fig. 9)

3. Concrete blocks:

Concrete blocks of various sizes were cast on the surface and then lowered and stacked on the concrete footings to form piers approximately 5′6" deep and 45′ wide. The heights of the piers varied depending on the footing elevation, but all stopped 2′ below Mean Low Water to receive granite blocks in the intertidal zone. Divers guided this operation by communicating with their tender on the surface via line-pull signals. "The signals of the diver are communicated verbally by the attendant (tender) to a director stationed upon the derrick, by which the buckets of concrete or blocks of beton are moved into position, and by him bells are rung, which enables the attendant at the engine to execute the necessary movements." (32) Drawings indicate that the first course consisted of oversize blocks approximately 5′x 9′x 15′ laid flat to provide a

wide footing. (Fig. 10) The following courses were laid on edge (on the 5'6" side) and were probably keyed together with concrete bags placed in recessed keyways cast into the joint face. This is definitely true for the top course of block where it joins with the granite blocks as evidenced by section drawings of the piers. (Fig. 11)

4. Granite:

Granite blocks were dressed and set in mortar on top of the concrete blocks up to elevation 2' M.H.W. A hollow area behind the granite was filled with concrete to bond the blocks into a unified mass. Seats were cut in the top course of the granite blocks to receive the iron girders.

5. Girders, Centers and Deck:

Iron girders were lifted by the 10 ton derrick and seated in place atop the granite piers. (Fig. 12) Arched wooden forms called "centers" were lifted into place between the girders and brought to bear on the piers. (Fig. 13) Iron tie-rods were installed across the width of the pier connecting the two side girders and running through each of the main girders. When drawn up tight, the girders effectively clamped the centers making tight formwork ready to receive the concrete for the deck. The centers were oiled and 95 yards of concrete was set between the girders for each span. Upon completion of each span in this manner, the deck was "floated off" with 85 c.y. of mortar to achieve a smooth surface with a 3" crown in the center. A more complete description of the construction process is contained in Appendices C & D.

6. The Building on Pier "A":

The building on the pier was begun in September, 1885 and completed in March of 1886. Mr. Charles O. Brown was the general contractor, with plumbing , gas and heating contracts going out to seperate firms. A detailed account of the construction of the building is given in the "Summary of the Journal of the Work for the Year Ending April 30th, 1886", contained in the 16th Annual Report of the Department of Docks and presented in its entirety in Appendix E.

CONCLUSION

The original intent of this study was to investigate the importance of Pier A and it's builder, George S. Greene, Jr. to the history of maritime engineering. At the outset, it was known that the Pier represented early concrete technology and might be worthy of reconition as an engineering landmark. What was not anticipated however, was the significant impact that Greene and the Dock Department have had on America's maritime heritage. Not only was the physical character of the New York City waterfront permanently altered through their actions, but the cultural aspects of how waterfronts are used and controlled was also permanently changed. Just as the congestion of buildings led New York City to set their much copied example of zoning law, the congestion of the waterfront led the city to set the example of waterfront regulation some fifty years earlier.

Within the scope of this report it was not possible to thoroughly analyze and discuss all of the new information that was uncovered. The findings that have been presented often raise larger questions about the historical impact of the events discussed. This resulted from limiting the study to the years prior to the completion of Pier A in 1886. Greene worked with the Dock Department until 1897 and many of the journal articles which spread his influence came out in these later years. (see Bibliography) More work is needed to properly establish the national significance of Greene, the Department and Pier A.

In closing, to all those that may go forth in the study, preservation and reuse of Pier A, I offer for inspiration the following excerpt from the "Memoir of George Sears Green, Jr." in the 1925 Transactions of the American Society of Civil Engineers:

> "On December 27, 1897, the Hon. Henry F. Dimock, Dock Commissioner made an interesting address at the 'placing of a stone to commemorate the work of dock improvement between Charles and West 23d Streets, North River', in which he stated:

'This City owes a particular debt of gratitude to one man whose merit is only equalled by his modesty. That man is Mr. George S. Greene, Jr., the accomplished Engineer in Chief of the Department. This plan is his child. He originated it; and he alone. By his forceful advocacy he has kept it alive during all these years and has won for it the approval of all the many Commissioners that have come and gone, and all the intelligent men who have given him a hearing. This is indeed his day of triumph. He has occupied his present position for more than twenty-two years, under commissioners of every shade of politics; always giving service of the upmost professional value. A man of the highest character, of an integrity so known of all men that no breath of suspicion has ever reached him. He has stood there as an object lesson to prove that sometimes the highest professional and personal qualifications are recognized, even in official life. His retention for such a period has done infinite honor to the long line of commissioners under whom he has served. It is certainly the hope of all who are interested in the water front that the time may be far distant when the City must be subjected to the loss of his services.' (34)

NOTES

1 John D. Van Buren, Jr., "The Waterfront of the City of New York," Transactions of the American Society of Civil Engineers 3 (1874): 172-189.

2 First Annual Report of the New York City Department of Docks (New York: Evening Post Job Printing Office, 1871): 10.

3 Ibid., 9.

4 Ibid., 10.

5 Ibid., 14.

6 Second Annual Report of the New York City Department of Docks (New York: Evening Post Job Printing Office, 1872): 20.

7 Ibid., 49.

8 Ibid., 38.

9 Ibid., 41.

10 Van Buren, 178.

11 Hamilton Schuyler, "Fabrication of Beton Blocks by Manual Labor" Transactions of the American Society of Civil Engineers 4 (1875): 93.

12 Ibid., 98.

13 "New York Dock Walls," Engineering Record (Sept. 3, 1892): 211.

14 Ibid.

15 Fifth Annual Report of the New York City Department of Docks (New York: Evening Post Job Printing Office, 1875): 18.

16 Walter Robert Kinipple, "Concrete Work Underwater," Proceedings of the Institute of Civil Engineers 87 (16 November 1886): 67.

17 Fifth Annual Report of the New York City Department of Docks, 39.

18 See: Allen Johnson and Dumas Malone, Dictionary of American Biography vol.4 (New York:Schribner and Sons, 1964): 566-568; and "Memoir of George Sears Greene, Jr.," Transactions of the American Society of Civil Engineers 88 (1925): 1392-1395.

19 Twelfth Annual Report of the New York City Department of Docks (New York: Evening Post Job Printing Office, 1882): 39-45.

20 Ibid., 41.

21 Ibid., 45.

22 "Statement of Operations Since the Date of the Last Annual Report. Engineers Bureau. February 9, 1872," (Addendum to the) Second Annual Report of the New York City Department of Docks (New York: Evening Post Job Printing Office, 1872): 6.

23 Fourteenth Annual Report of the New York City Department of Docks (New York: Evening Post Job Printing Office, 1884): 127.

24 Fifteenth Annual Report of the New York City Department of Docks (New York: Evening Post Job Printing Office, 1885): 111.

25 Ibid., 127.

26 Carleton Greene, Wharves and Piers (New York:McGraw Hill Book Co., 1917): 112.

27 Ibid.

28 Ibid., 238.

29 Ibid., 154.

30 Fifteenth Annual Report of the New York City Department of Docks, 112.

31 Ibid., 127.

32 Park Benjamin, Ed., Appleton's Cyclopaedia of Applied Mechanics (New York: D. Appleton and Co., 1885): 455.

33 Van Buren, 178.

34 Memoir of George Sears Greene, Jr." Transactions of the American Society of Civil Engineers 88 (1925): 1394.

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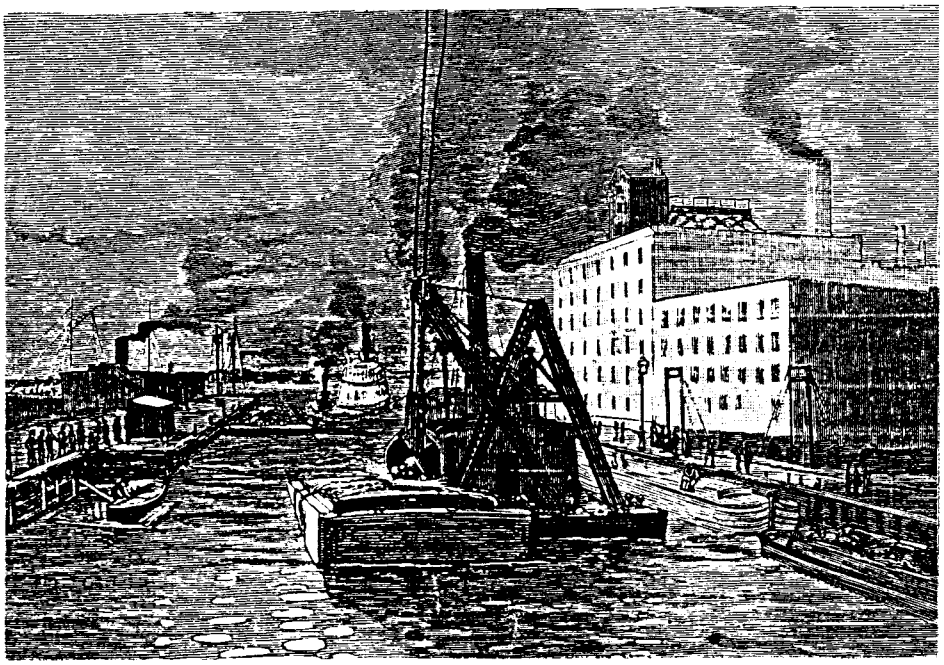
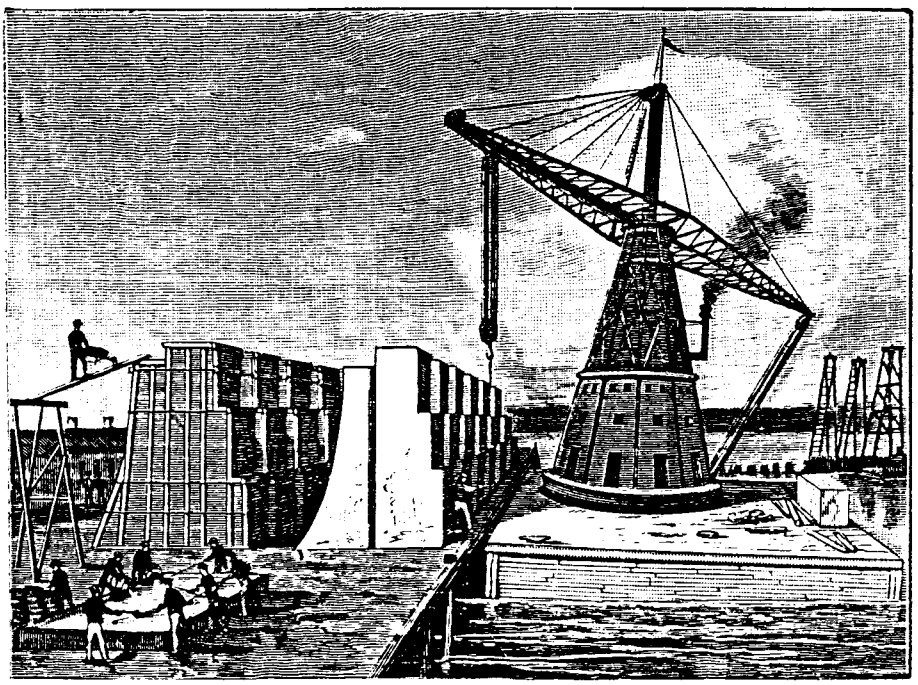


FIGURE 1

(Scientific American, June 6, 1896. p.355)

Dredging out slips was one of the first tasks undertaken by the Department of Docks after its formation in 1870. This same dredge with its clamshell bucket may have done the dredging for the footings of Pier A.



THE GREAT DERRICK OF THE DOCK DEPARTMENT.

FIGURE 2

(Scientific American, June 6, 1896. p.355)

The floating derrick is of a design known as a "Bishop's Plan according to Van Buren who state's that it was "designed by Mr. Issac Newton of this city, a very complete and excellent machine." (33) Issac Newton was an assistant engineer with the Dept of Docks when it was first organized in 1870. The machine was designed and built in 1871.

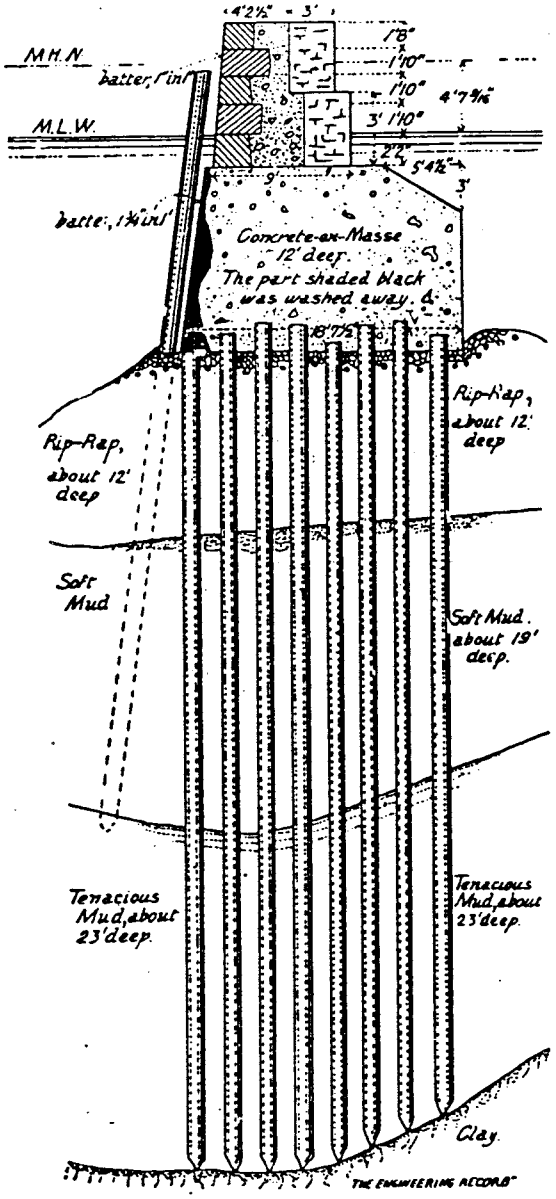


FIG. 1.—OLD DOCK WALL, NEW YORK.

(From report of Generals Newton and Gillmore and Mr. William E. Worthen.)

FIGURE 3

(Engineering Record, Sept. 3, 1892. p.211)

Section Drawing of the dock wall built between 1873 and 1875 by Engineer in Chief Gen. Charles K. Graham. Graham implemented the concrete-en-masse method which, for numerous reasons, literally fell apart. Graham resigned and George S. Greene, Jr. was hired to replace him.

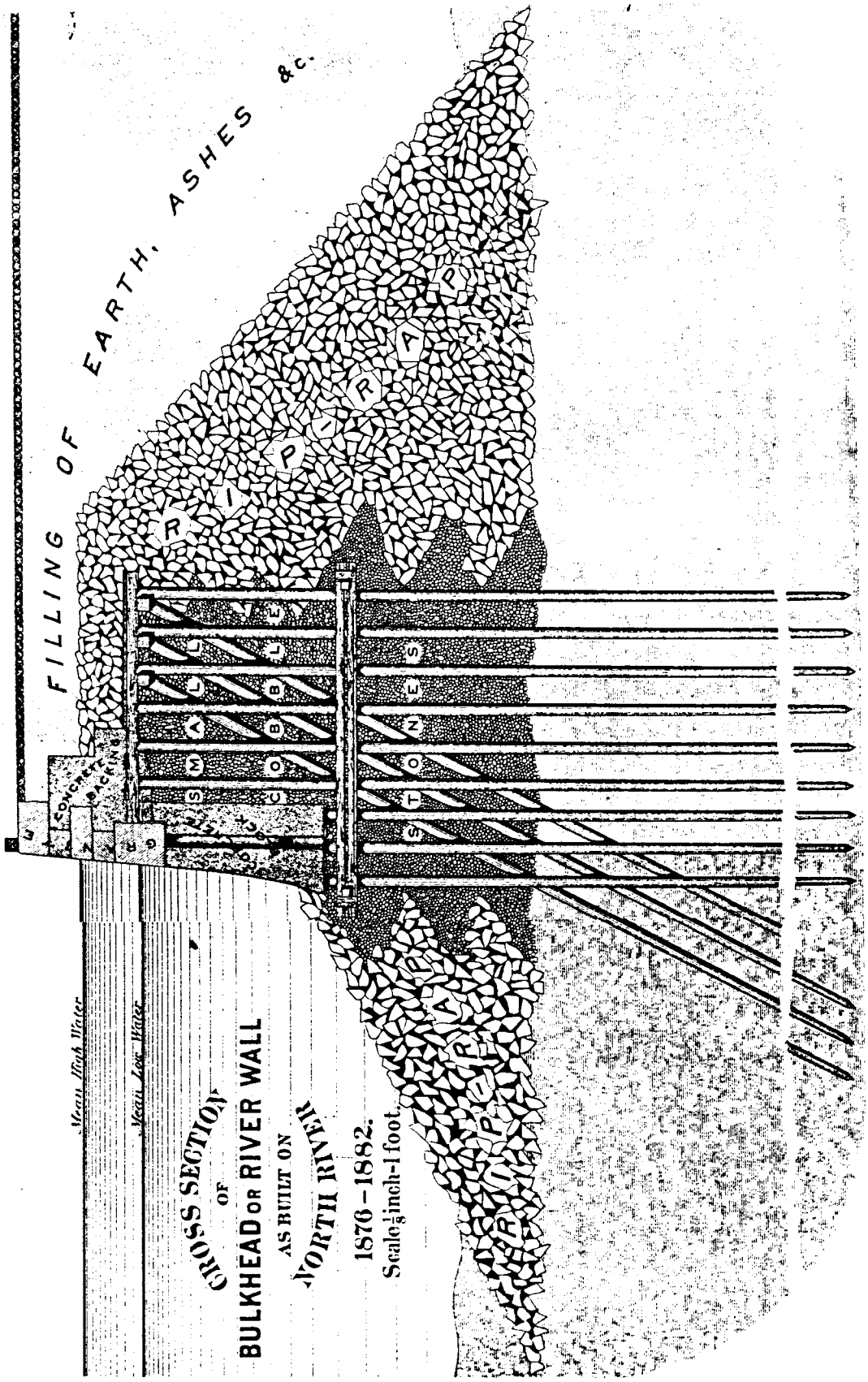
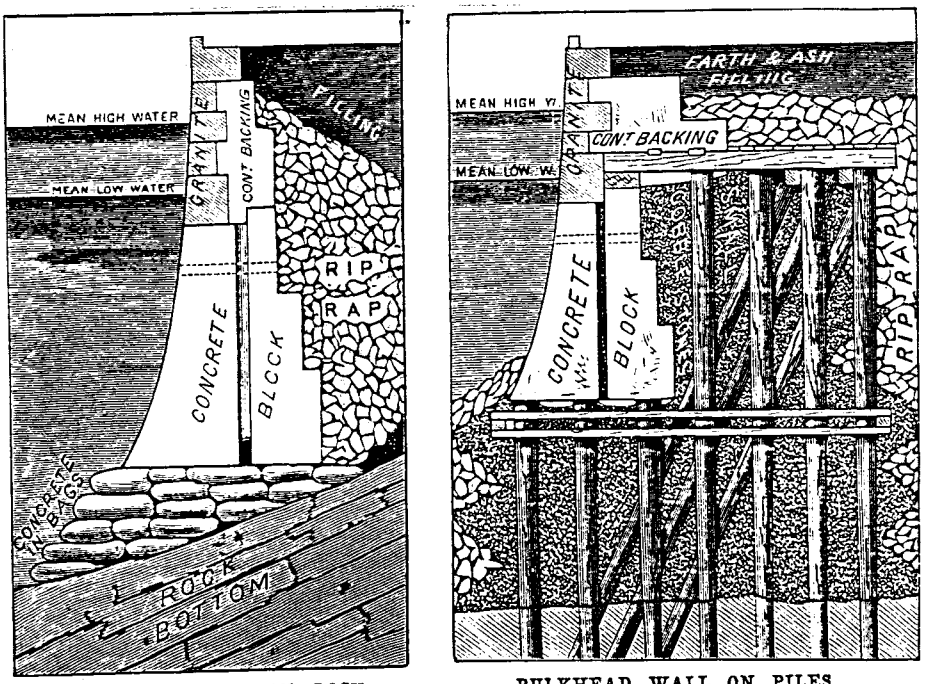


FIGURE 4

(12th Annual Report of the Dept. of Docks. 1882)

The "New River Wall" as designed by George S. Greene, Jr. which met with full approval of a special engineering commission appointed to evaluate it.



BULKHEAD WALL ON ROCK.

BULKHEAD WALL ON PILES.

FIGURE 5

(Scientific American, June 6, 1896. p.300)

Variations of Greene's bulkhead walls depending on bottom conditions.

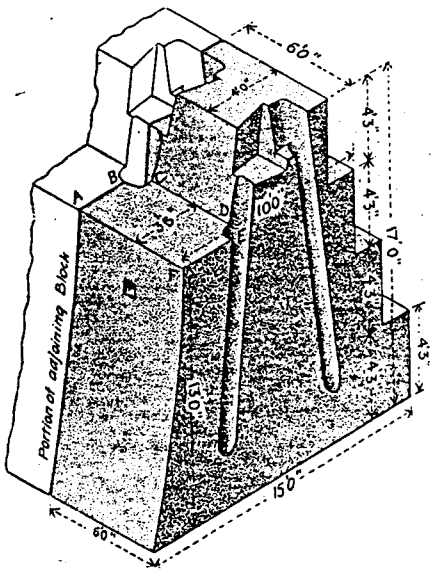


Fig. 2. Concrete Block Used in Bulkhead Construction, New York.

FIGURE 6

(Engineering News, Feb. 2, 1893. p.104)

Detail of Greene's improved concrete block from an article by him referenced above.

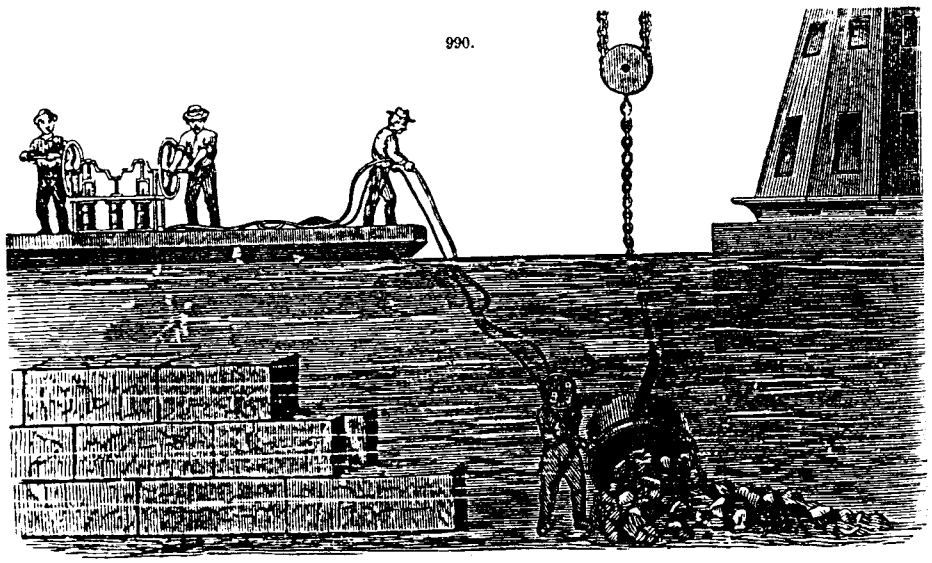


FIGURE 7

(Appletons Cyclopaedia of Applied Mechanics, 1885. p.454)

Dock Department diver constructing an early section of bulkhead entirely of granite, probably near the Battery and Pier A.

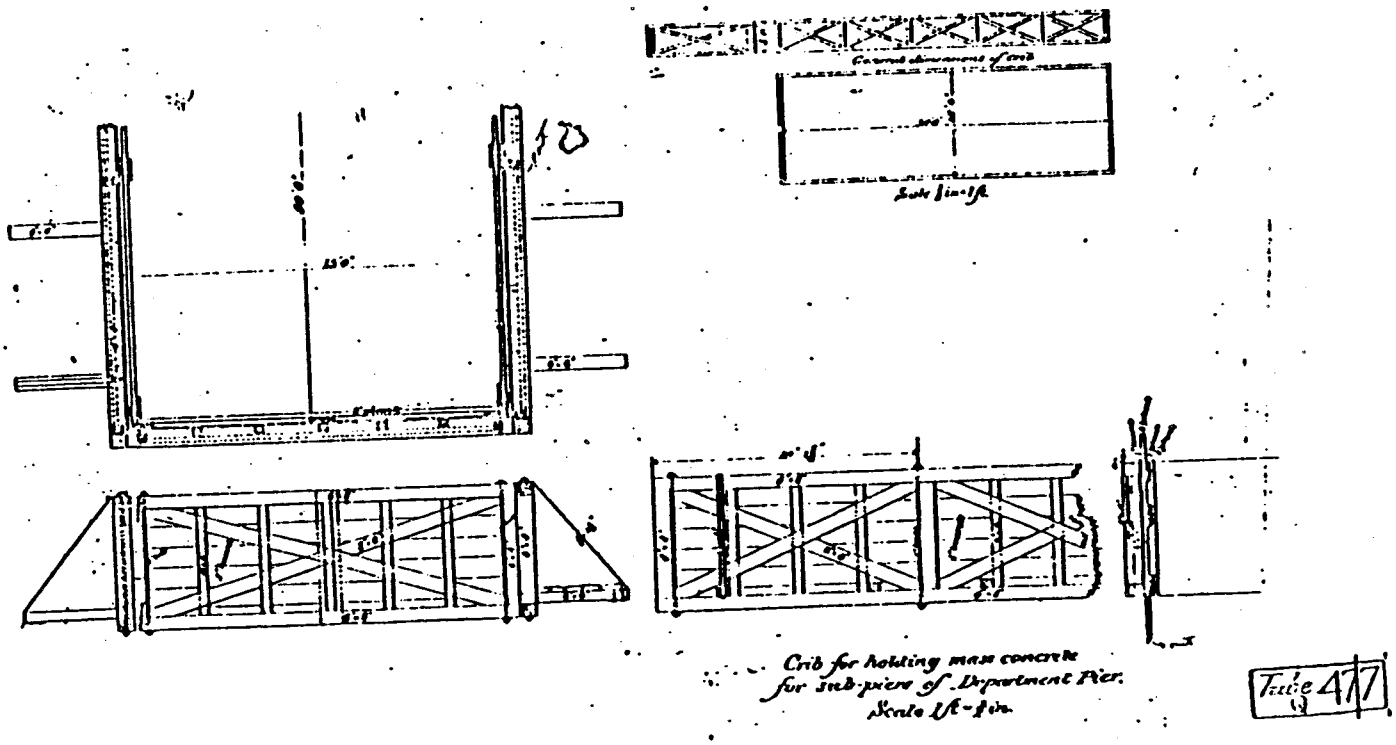


FIGURE 8

Drawing of wooden cribs for holding mass concrete for the sub-piers of Pier A. These cribs were ballasted with rock and lowered into position by a floating derrick.

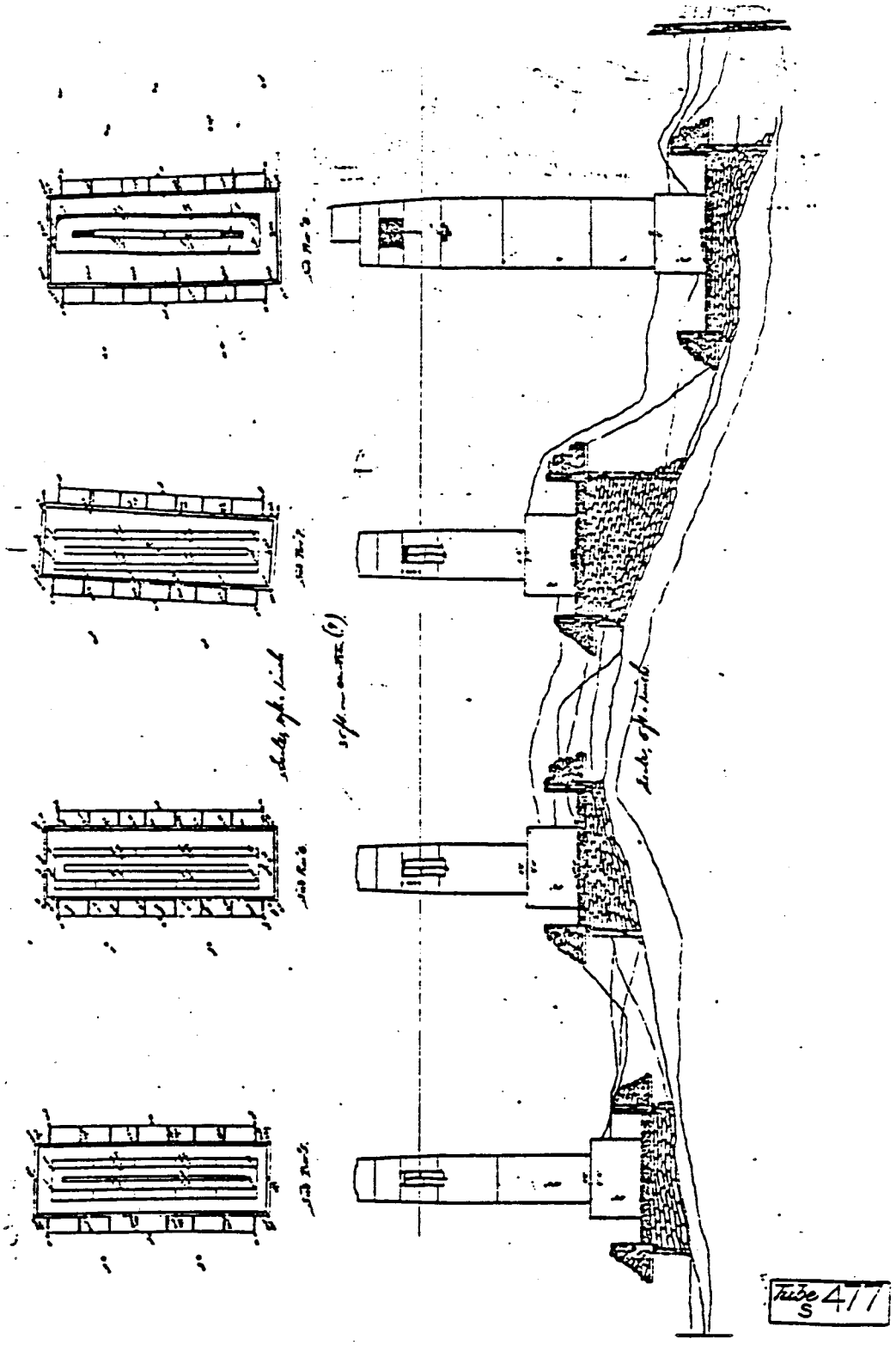


FIGURE 9

Section through piers 5-8. The cribs were leveled and the space between the bedrock and the crib bottom was filled with concrete in burlap bags. Mass concrete was dumped in the crib and leveled. The concrete block piers were then constructed on these sub-footings.

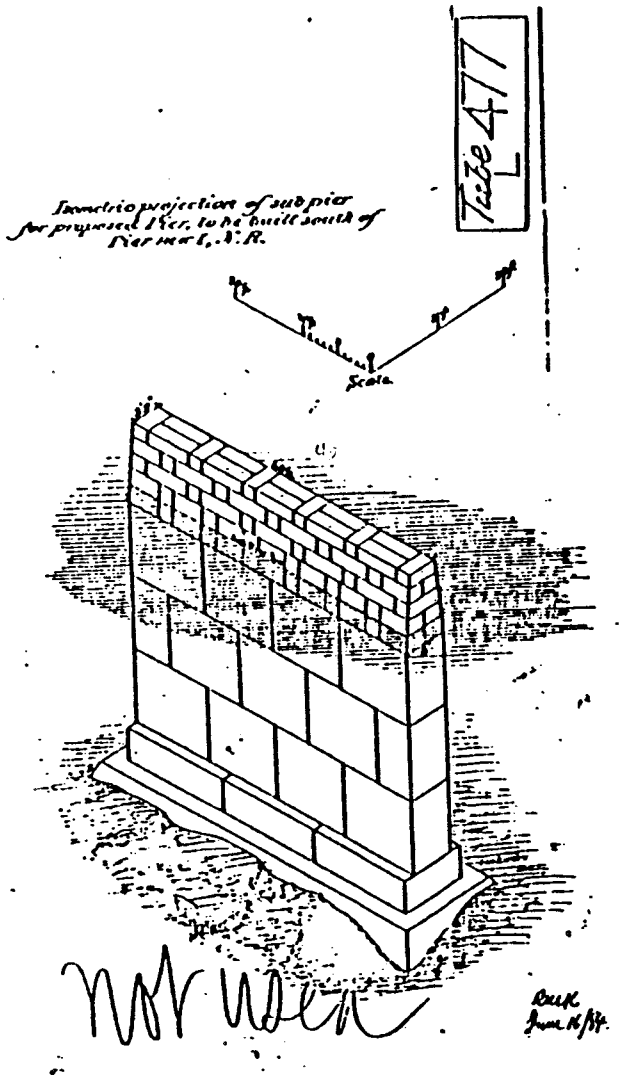


FIGURE 10

Isometric drawing of typical pier supporting the deck of Pier A.

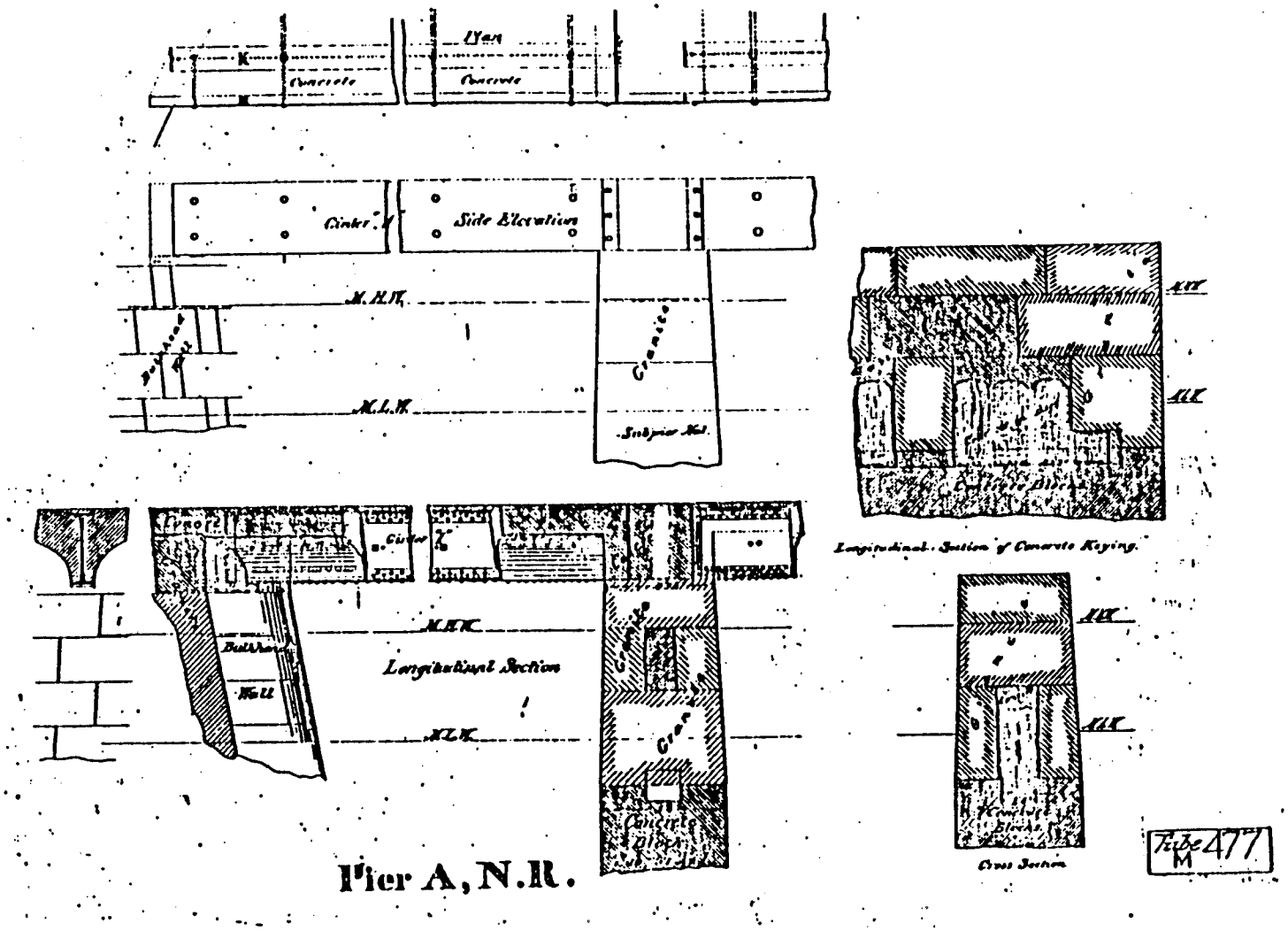


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FIGURE 11

Section through bulkhead wall, deck and pier # 1 of Pier A. Notice concrete blocks end 2 feet below M.L.W. and granite blocks finish the piers up to the deck.

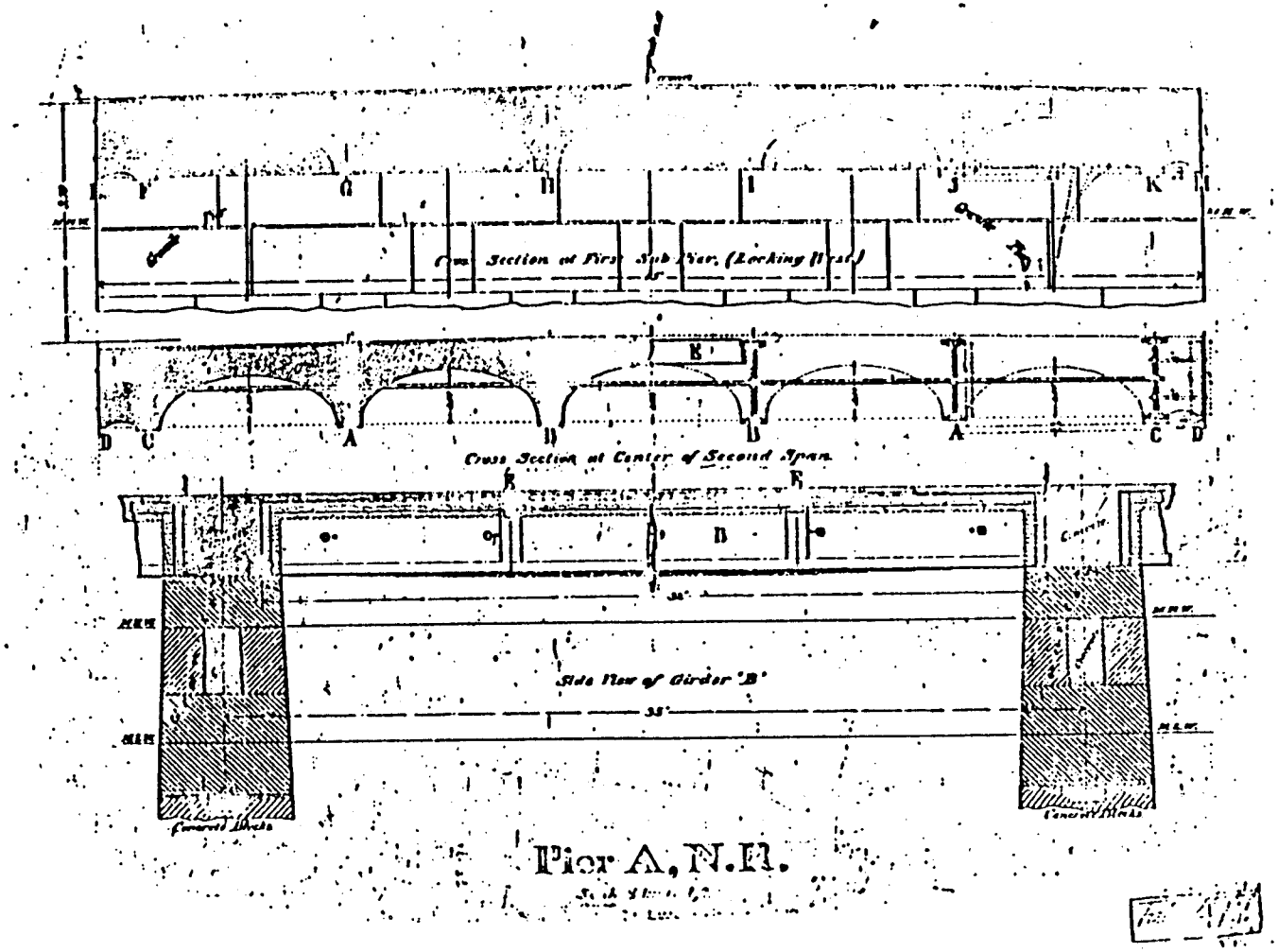

FIGURE 12

Cross section of Pier A deck and sub-pier showing arched concrete deck constructed between iron girders.

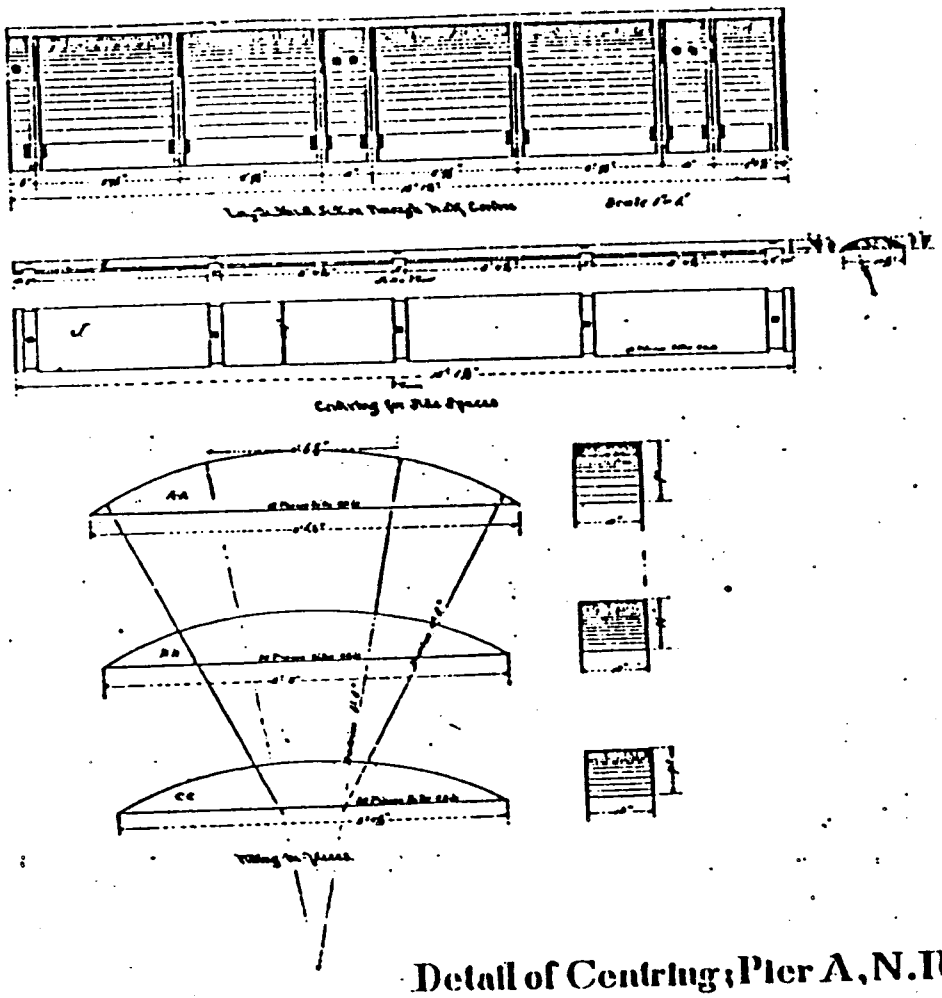

FIGURE 13

Detail of the wooden centring, the wooden form used to cast the arched concrete deck between the girders.

APPENDIX

A. Page 127 of the Twelfth Annual Report of the Department of Docks, 1882.

B. Pages 111 - 113, of the Fifteenth Annual Report of the Department of Docks, 1885.

C. Pages 127 - 143 of the Fifteenth Annual Report of the Department of Docks, 1885.

D. Pages 95 - 97 of the Sixteenth Annual Report of the Department of Docks, 1886.

E. Pages 109 - 121 of the Sixteenth Annual Report of the Department of Docks, 1886.

F. Pages 95 and 117 of the Seventeenth Annual Report of the Department of Docks, 1887.

APPENDIX.

SUMMARY OF THE JOURNAL OF THE WORK FOR THE YEAR ENDING APRIL 30TH, 1884.

WORK OF CONSTRUCTION UNDER THE NEW PLAN.

NORTH RIVER WATER FRONT.

PROPOSED NEW PIER BETWEEN THE CASTLE GARDEN AND PIER NEW 1, N. R., FOR THE USE OF THE POLICE DEPARTMENT AND THE DEPARTMENT OF DOCKS.

November 15th to 24th, 1883.—An examination of the site for the new pier was made with the boring machine "Woodcock."

CHAMBERS STREET SECTION.

Resolutions of Board, November 24th, 1877, and November 21st, 1878.

FILLING IN REAR OF THE WALL.

May 1st to 27th, 1883—1,218 loads of earth filling were received on tickets, and placed where settlement had taken place. 503 loads of the above were used to fill up between the sills for the roadway to Pier New 21, North River.

APPENDIX A

DEPARTMENT OF DOCKS.

117 AND 119 DUANE STREET.

OFFICE OF THE ENGINEER-IN-CHIEF,

NEW YORK, 1st May, 1885.

To the Board of Docks:

GENTLEMEN,—I have the honor to submit for your consideration the following report of the several works under my supervision during the year ending 30th April, 1885.

NORTH RIVER.

WORK UNDER NEW PLAN.

Sections South of Canal Street.

BATTERY SECTION.—Embracing the Boat Landing, Pier New 1 North River, and about 80 feet of Bulkhead north of Pier New 1.

Some small repairs have been made on this section during the past year.

On the 3d July, 1884, it was directed, by unanimous resolution of the Board, to proceed with the construction of a pier for the uses of this Department and also of the Police Department, in accordance with a plan submitted to the Board on that day.

This pier is to be 45 feet wide and 285 feet long. It springs from the corner of the bulkhead or river wall south of New Pier 1, North River, at an angle with the main length of the wall of 116½ degrees. The pier consists of 8 sub piers outside of the wall, supporting a deck, or floor, of iron girders with concrete arches between them, and is known as "Pier A, foot of Battery place, North River."

As the borings and soundings showed the rock to be only about 18 feet below mean low water, as a minimum, with soft mud on top of the rock, affording no holding ground for piles of either wood or iron, the foundations were made by clearing the mud off the rock, then sinking a box or crib of cheap timber upon the site of the sub-pier foundation, and filling the same up to a certain height with concrete in bags carefully laid by submarine divers under water. Mass concrete was then placed over the bags and levelled off, to form a seat or bed for the concrete blocks made in air, which extend from the above described foundation to a height two feet below mean low water mark. Above these concrete base blocks the sub-piers were built of granite to a level 2 feet above mean high water mark.

The top of the pier resting on these sub-piers consists of 6 main girders and 2 side girders, extending from sub-pier to sub-pier, each girder being 3 feet in depth, and a concrete arch being sprung between each two girders; the top of the arches forming the deck or floor of the pier, which is to be covered with an asphalt pavement two inches in thickness.

The deck of the pier is 5 feet 3 inches above mean high water at its sides, and has a camber of 3 inches in its centre.

Work was vigorously pushed and the pier could have been completed by 1st January, 1885, if the furnishers of the granite had delivered it at the time they agreed to. By the specification of the Treasurer's order, the granite was to have been all delivered between 10th September, 1884, and 19th November, 1884, but the first cargo was not delivered until 3d November, 1884, and the last 21st April, 1885.

At this date Sub-Piers 4, 5, 6, 7 and 8 are completed.

The iron girders are set on the spans from Sub-Piers 4 to 8, and the concrete arches built between Sub-Piers 6 and 7, and partially built between Sub-Piers 5 and 6 and 7 and 8.

The concrete foundation of Sub-Pier No. 1 is finished, and also those of Sub-Piers 2 and 3, except the top courses of concrete blocks. The granite is partially set on Sub-Pier No. 1.

The granite being now delivered, the work will proceed to completion.

CHAMBERS STREET SECTION.—Extending from the north side of Pier Old 29 to 91.70 feet north of the north side of Pier New 21, a distance of 651.70 feet.

Length of piling to date	670.50	feet.
" base blocks to date	603.42	"
" "E" course of granite to date	569.64	"
Equivalent length of completed wall to date	589.40	"

Levels have been taken on the newly-made land to ascertain its rate of settling. Some small repairs have been made to Department office and to old shed south of Pier Old No. 33.

NORTH MOORE STREET SECTION.—Extending from a point 21 feet south of the south side of Pier New 26, North River, to a point half way between North Moore street and Franklin street, a distance of about 340 feet.

Dredging to date	190.00	feet.
Stone filling to date	160.00	"
Equivalent length of completed wall	34.66	"

Nothing has been done on this section, the injunction of 7th July, 1881, being still in force.

BEACH STREET SECTION.—Extending from 21 feet south of the south side of Pier New 26 to 95 feet north of the north side of Pier New 26, a distance of 196 feet.

APPENDIX.

SUMMARY OF THE JOURNAL OF THE WORK FOR THE YEAR ENDING APRIL 30TH, 1885.

WORK OF CONSTRUCTION UNDER THE NEW PLAN.

NORTH RIVER WATER FRONT.

BATTERY SECTION.

PIER A.

Resolution of the Board, July 15th, 1884.

BORINGS.

June 2d, 7th to 18th, and July 1st to 5th, 1884.—Borings were taken over the site of the proposed pier with the borer "Woodcock."

DREDGING.

July 23d to August 15th, 1884.—The Union Dredging Company (under Treasurer's order No. 11,016) excavated and removed 3,516 cubic yards of mud, and (under Treasurer's order No. 11,067) removed 598 cubic yards of boulders, stone, &c., from the site of the proposed pier. The divers assisted in the latter work.

August 15th, 1884.—The diver examined the sites for the sub-piers.

ABUTMENT.

October 13th to 20th, 1884.—Recesses to receive the inner ends of the girders were cut in the coping of the bulkhead wall by Department stone-cutters, who wedged out the pieces of granite after the holes had been drilled by the steam drill.

October 14th to 23d, 1884.—100 holes, 2 inches in diameter and 30 inches deep, were drilled in the coping, for the recesses, with a steam drill, by T. E. Crimmins, under Treasurer's order No. 11,187.

EXTRA FOUNDATION NEAR THE ABUTMENT.

November 17th to December 2d, 1884.—The rip-rap was removed by the divers from the footing of the bulkhead wall, on the line of the southerly side of the pier, to prepare for placing the foundation for a structure to support the corner of the proposed building on the pier.

December 10th, 15th, 16th and 22d, 1884.—A survey and examination was made of the area cleared of rip-rap, the divers assisting.

SUBSTRUCTURE.

SUB-PIER No. 1.

Piling.

July 22d to August 2d, 1884.—82 piles were driven for the foundation.

October 14th to 16th, 1884.—The mud was removed from between the piles by means of a water jet, the divers assisting.

October 21st to November 1st, 1884.—82 piles were cut off at 21.8 feet below mean low water mark, with the circular saw, the divers assisting.

November 17th, 1884.—The piles were located by the diver by means of a wire netting frame work.

November 19th and 20th, 1884.—9 extra piles were driven in the foundation.

November 21st and 22d, 1884.—9 extra piles were cut off at 21.8 feet below mean low water mark, with the circular saw.

November 25th, 1884.—The diver located the extra piles driven in the foundation.

91 piles in all were driven in the foundation to an average depth of about 30 feet below mean low water, and sawed off at a depth of about 21.8 feet below mean low water.

STONE FILLING.

November 7th and 8th, 1884.—The mud was removed from between the piles by means of a water jet, the diver assisting.

November 11th to 13th, 1884.—144 cubic yards of cobbles were deposited by Christopher Havican, under Treasurer's order No. 11,049.

November 17th to 29th, 1884.—The divers cleared the tops of the piles from the rip-rap and cobbles among them.

CONCRETE BLOCKS.

November 12th to 17th, 1884.—Sights were placed and preparations made for setting concrete blocks.

November 18th to 29th, 1884.—9 concrete blocks were set by the derrick "City of New York," the divers assisting.

March 6th and 7th, 1885.—Guides for setting blocks were placed.

March 13th and 14th, 1885.—3 concrete blocks were set by the derrick "City of New York," the divers assisting.

March 13th and 14th, 1885.—Recesses were cut in the blocks for keying the granite to the blocks.

March 16th, 1885.—Levels were taken on the blocks set.

In all, 12 concrete blocks, containing 219¼ cubic yards of concrete, were placed in this sub-pier.

Granite.

April 24th to 29th, 1885.—16 pieces of granite, containing 815.45 cubic feet, were set with 8 batches of mortar, and backed with 10

batches of concrete, 6.3 cubic yards. The masons were also dressing the granite and calking the joints. The granite for this pier is not yet completed.

SUB-PIER No. 2.

Soundings.

August 27th, 1884.—Rod soundings were taken by the surveyors, assisted by the crew of the derrick "City of New York," over the site of sub-pier.

Crib.

August 30th to September 4th, 1884.—The crib, 15 feet by 50 feet in area and 5 feet in height (average dimensions), was set, taken up and reset by the derrick "City of New York." The crib was loaded with rip-rap to sink it, and guided to place by spuds. Guide pieces were placed on it to guide the divers in placing the concrete.

September 1st to 4th, and 18th to 22d, 1884.—The mud, sand, etc., were removed from the crib by a water jet operated from pile driver No. 5, and a steam pump, the divers assisting.

September 23d to 30th, 1884.—108 batches of concrete in bags (68.04 cubic yards), and 69 batches (43.47 cubic yards), loose in buckets, were placed in the crib, the divers assisting and leveling up.

Concrete Blocks.

October 2d, 1884.—The surveyors, assisted by the crew of the derrick "City of New York," gave points for guides for setting the concrete blocks.

October 3d to 9th, 1884.—9 concrete blocks (192 cubic yards) were set on the crib foundation by the derrick "City of New York," the divers assisting.

October 10th and 11th, 1884.—Levels were taken on the blocks by the surveyors, assisted by the divers.

SUB-PIER No. 3.

Soundings.

August 27th, 1884.—Rod soundings were taken by the surveyors over the site of the sub-pier, the derrick "City of New York" being used, the divers assisting.

Crib.

September 5th, 1884.—The crib, 15 feet by 50 feet in area and 5 feet in height (average dimensions), was placed by the derrick "City of New York," and loaded with rip-rap to sink it to place.

September 6th, 1884.—Guide planks were placed by the diver on the crib to guide divers in placing the concrete.

September 8th and 22d to October 18th, 1884.—The mud, sand, etc., were removed from the site of the sub-pier by a water jet, operated from pile driver No. 5, and a steam pump, the divers assisting.

October 18th to 27th, 1884.—118 batches (74.34 cubic yards) of concrete in bags, and 78 batches (49.14 cubic yards) loose in buckets, were placed in the crib, the divers assisting.

Concrete Blocks.

October 31st to November 3d, 1884.—Points were given, and the crib foundation prepared by the divers for setting the base blocks.

November 5th to 10th, 1884.—12 concrete blocks (200.7 cubic yards) were set on the crib foundation by the derrick "City of New York," the divers assisting, and holes drilled in the blocks to receive dowels.

Granite.

April 22d and 23d, 1885.—The granite was cut, and preparations made for setting it.

SUB-PIER No. 4.

Soundings.

August 27th, 1884.—Rod soundings were taken by the surveyors, assisted by the crew of the derrick "City of New York," over the site of the sub-pier.

Crib.

September 18th, 1884.—The crib, 15 feet by 50 feet in area and 5 feet in height (average dimensions), was placed by the derrick "City of New York," and loaded with rip-rap to sink it to place, the divers assisting.

September 20th, 1884.—The sights were removed by the divers.

September 30th to October 6th, 1884.—The mud, sand, etc., were removed from the crib by the water-jet and steam-pump, the divers assisting.

October 7th, 1884.—Levels were taken on the crib, the divers assisting.

October 9th to 18th, 1884.—70 batches (44.1 cubic yards) of concrete in bags, and 94 batches (59.29 cubic yards) loose, in buckets, were placed in the crib, the divers assisting.

October 27th to 30th, 1884.—9 concrete blocks were set on the crib foundation by the derrick "City of New York," the divers assisting.

October 30th to 31st, 1884.—Levels were taken on the blocks.

March 10th, 1885.—Guides for setting concrete blocks placed in position, the divers assisting.

March 12th, 1885.—3 concrete blocks (total for the pier 12) were set by the derrick "City of New York," the divers assisting.

March 13th, 1885.—Levels taken on the blocks.

Granite

March 23d, to April 10th, 1885.—30 pieces (1765.87 cubic feet) of granite were dressed, and set with 14½ batches of mortar and 7½

batches of grout, and backed with 18 batches (12.34 cubic yards) of concrete, completing the granite for the sub-pier.

April 6th to 15th, 1885.—Seats for the girders were cut in the granite.

SUB-PIER No. 5.

Soundings.

August 28th, 1884.—Rod soundings were taken by the surveyors, assisted by the crew of the derrick "City of New York," over the site of the sub-pier.

Crib.

September 23d, 1884.—The crib, 15 feet by 50 feet in area, and 5 feet in height (average dimensions), was placed by the derrick "City of New York," the divers assisting, and loaded with rip-rap to sink it in place.

September 24th, 1884.—The sights were removed by the divers.

September 29th and 30th, 1884.—Mud, sand, &c., were removed from the crib by the water-jet and steam-pump, the divers assisting.

October 1st to 8th, 1884.—96 batches (60.48 cubic yards) of concrete in bags, and 79 batches (47.88 cubic yards) loose, in buckets, were placed in the crib, the divers assisting.

Concrete Blocks.

October 14th, 1884.—Points were given and guides placed on crib, and preparations made for setting the blocks.

October 15th and 17th, 1884.—9 concrete blocks were placed on the crib by the derrick "City of New York," the divers assisting.

December 4th and 5th, 1884.—3 concrete blocks were placed on the crib by the derrick "City of New York," the divers assisting.

December 8th and 9th, 1884.—Levels were taken on the blocks, the divers assisting. In all, 12 concrete blocks (238.23 cubic yards), were placed in this sub-pier.

Granite.

January 14th and 15th and 30th to February 2d, 1885.—The granite was dressed and prepared for setting.

February 3d to March 6th, 1885.—34 pieces of granite were dressed and set, and backed with 17½ batches (11.025 cubic yards) of concrete.

March 7th to 11th, 1885.—Seats for the girders were cut in the granite.

March 17th to 19th, 1885.—The joints in the blocks were located by the surveyors, the divers assisting.

March 26th and 27th, 1885.—2 pieces of granite were dressed and set in place. During the year, 36 pieces (1697.56 cubic feet) of granite was set in 18½ batches of mortar and 4 batches of grout, and backed with 17½ batches (11.025 cubic yards) of concrete, completing the granite for this pier.

March 26th and 27th, 1885.—Seats for the girders were cut in the granite.

SUB-PIER No. 6.

Crib.

August 4th and 5th, 1884.—Preparing to sink the crib.

August 7th, 1884.—The crib, 15 feet by 50 feet in area and 5 feet in height (average dimensions), was placed in position by the derrick "City of New York," the divers assisting, and loaded with rip-rap to sink it to place.

August 8th, 1884.—The north end of the crib was blocked up by the diver, and mud was removed from the crib by the water jet and steam-pump, the divers assisting.

August 9th, 1884.—The position of the crib was shifted about one foot by the derrick "City of New York," the divers assisting.

August 11th, 1884.—Guides for placing the concrete bags were set.

August 12th and 13th, 1884.—The mud, sand, &c., were removed from the crib by the water jet and steam pump, the divers assisting.

August 14th to 25th, and September 5th to 10th, 1884.—179 batches (112.77 cubic yards) of concrete in bags, and 79 batches (44.73 cubic yards) of concrete loose in buckets, were placed in the crib, the divers assisting in placing and leveling off for the blocks.

Concrete Blocks.

September 11th and 12th, 1884.—Points were given, and guides placed on the crib, and preparations made for setting the blocks.

September 13th to 15th, 1884.—5 concrete blocks were placed on the crib by the derrick "City of New York," the divers assisting.

September 24th, 25th, 29th and 30th, 1884.—Points were given and guides placed, and preparations made for setting the balance of the blocks.

October 1st, 1884.—3 concrete blocks, making a total of 8 blocks for this sub-pier, were placed on the second course by the derrick City of New York, the divers assisting.

October 15th, 1884.—Levels were taken on the blocks, the divers assisting.

Granite.

November 1st to December 1st, 1884.—36 pieces (1781.92 cubic feet) of granite were dressed and set by the 10-ton derrick, with 11½ batches of mortar and 5 batches of grout, and backed with 15½ batches (9.765 cubic yards) of concrete, completing the granite for this sub-pier. The joints were calked by the diver.

December 2d to 5th, 13th to 20th, 1884, and January 3d, 1885.—The top course of granite was dressed down and seats for the girders cut in the granite.

C-13

SUB-PIER No. 7.

Crib.

August 11th and 12th, 1884.—The site for the crib was examined, the derrick "City of New York" being employed, and the divers assisting.

August 13th to 15th, 1884.—The crib, 15 feet by 50 feet, in place by 5 feet in height (average dimensions) was placed in position by the derrick "City of New York," weighted with rip-rap to sink it, and wedged into position, the divers assisting.

August 25th to September 15th, 1884.—351 batches (221.13 cubic yards) of concrete in bags, and 63 batches (39.69 cubic yards) of concrete loose in buckets, were placed in the crib, the divers assisting in placing and leveling off.

Concrete Blocks.

September 17th and 18th, 1884.—Points were given and sights placed for setting blocks, the divers assisting.

September 19th and 20th, 1884.—5 concrete blocks were set on the crib by the derrick "City of New York," the divers assisting.

September 20th, 1884.—Levels were taken on the blocks set, the divers assisting.

October 10th and 11th, 1884.—3 concrete blocks were set on the top course, making a total of 8 blocks (168.5 cubic yards) in this sub-pier, by the derrick "City of New York, the divers assisting.

October 13th, 1884.—Levels were taken on the top course of blocks, the divers assisting.

October 14th, 1884.—The guide planks were removed by the divers.

Granite.

November 8th to December 13th, 1884.—36 pieces (1809.90 cubic feet) of granite were dressed and set, with 12 batches of mortar and 20½ batches of grout, and backed with 16 batches (10.08 cubic yards) of

concrete. The derrick "City of New York" was employed in setting 5 pieces. The divers assisting.

December 16th, 1884, to January 3d and March 13th, 1885.—Seats for the girders were cut in the granite and the top surface of the sub-pier dressed down to the required grade.

SUB-PIER No. 8.

Soundings.

August 11th, 1884.—The site for the crib was examined, the derrick "City of New York" being employed, the divers assisting.

August 18th, 1884.—Rod soundings were taken by the surveyors over the site of the sub-pier, the derrick "City of New York" being used, and the divers assisting.

Crib.

August 19th to 23d, 1884.—The crib, 20 feet by 50 feet in area by 5 feet in height (average dimensions), was placed in position by the derrick "City of New York," weighted with rip-rap to sink it, reset, its location tested, and the sights removed, the divers assisting.

August 28th to September 1st, 1884.—The mud, sand, &c., were removed from crib by the water jet operated from pile driver No. 5, and a steam pump, the divers assisting.

September 2d, 1884.—The crib was located by the surveyors, the derrick "City of New York" being used, the divers assisting.

September 5th to 23d, 1884.—191 batches (120.33 cubic yards) of concrete in bags, and 69 batches (43.47 cubic yards) of concrete loose in buckets, were placed in the crib, the divers assisting and leveling off.

Concrete Blocks.

September 24th, 1884.—Points were given and guides for setting blocks were placed on the crib, the diver assisting.

September 27th and 29th, 1884.—5 concrete blocks were placed on the crib by the derrick "City of New York," the divers assisting.

October 20th to 23d, 1884.—6 concrete blocks were placed by the derrick "City of New York," the divers assisting.

October 23d, 1884.—Levels were taken on the blocks.

October 27th, 1884.—1 concrete block was set by the derrick "City of New York" and levels taken thereon, the divers assisting.

December 11th to 13th, 1884.—3 concrete blocks, a total for the sub-pier of 15 (393.5 cubic yards), were placed by the derrick "City of New York," and levels were taken on the blocks, the divers assisting.

Granite.

November 29th, December 16th to 18th, 1884, and January 7th to 9th, 1885.—Cutting and preparing to set granite.

January 13th to February 15th and 26th, to March 3d, 1885.—50 pieces (2,116.85 cubic feet) of granite were set with 28½ batches of mortar, and 18½ batches of grout, and backed with 42 (17.955 cubic yards) batches of concrete, the diver assisting.

March 14th and 15th, 1885.—9 pieces (581.31 cubic feet) of coping were set, using 5½ batches of mortar and 3 batches of grout.

March 12th to April 22d, 1885.—Seats for the girders were cut in the granite, and the granite and coping dressed. 2 pieces of granite were brought from the East Seventeenth street yard, and cut to fit as closing pieces between the coping and the ends of the side girders.

April 21st, 1885.—The 2 extra pieces (190.2 cubic feet) of granite were set as closers, with 1 batch of mortar.

STONE FILLING.

July 29th, 1884.—A load of rip-rap was delivered by Christopher Havican, and discharged by him, on the pier at Bogart street, and afterwards placed around the foundations of the sub-piers by the Department forces.

October 11th to November 10th, 1884.—2,011 cubic yards of rip-rap were deposited by Christopher Havican (under Treasurer's orders Nos. 11,048 and 11,158) around and between the sub-piers. The divers leveled off the rip-rap.

October 17th to 19th, 1884.—The rip-rap deposited on the pier at Bogart street was transferred to Pier "A" by Department forces.

December 3d and 6th and 19th, 1884.—Levels were taken on the rip-rap between the sub-piers, the divers assisting.

December 9th, 1884.—Rip-rap was removed from sub-pier No. 4 by the divers.

Delivery of Granite.

October 30th to November 3d, 1884.—The first load of granite was delivered and discharged by Christopher Binder's Sons, under Treasurer's order No. 11,068.

November 5th to 8th, 1884.—The second load of granite was delivered and discharged by Christopher Binder's Sons, under Treasurer's order No. 11,068.

December 6th, 1884.—Some of the granite delivered by C. Binder's Sons were dressed by the Department stone-cutters, to make them conform to the specifications, at the expense of C. Binder's Sons.

January 16th to 21st, 1885.—The third load of granite was delivered and discharged by C. Binder's Sons, under Treasurer's order No. 11,068.

March 11th to 19th, 1885.—The fourth load of granite was delivered and discharged by C. Binder's Sons, under Treasurer's order No. 11,068.

March 25th and 26th, 1885.—Several of the pieces of granite delivered by C. Binder's Sons were recut by the Department stone-cutters, to make them conform to the specifications, the expense to be charged to C. Binder's Sons.

April 17th to 21st, 1885.—The fifth load of granite was delivered and discharged by C. Binder's Sons, under Treasurer's order No. 11,068.

SUPERSTRUCTURE.

SPAN No. 5.

Girders.

April 11th, 13th, and 17th to 20th, 1885.—The girders were placed in position by the 10-ton derrick, and extra holes were drilled in them in which to place tie-rods to hold them in line.

Centers.

April 14th to 18th, 1885.—The centers were placed in position by the 10-ton derrick.

SPAN No. 6.

Girders.

March 17th to 19th, and 26th to 28th, 1885.—The girders were placed in position between Sub-Piers Nos. 5 and 6 by the 10-ton derrick.

March 31st, 1885.—Extra holes were drilled in the girders in which to place tie-rods to hold them in line.

Centers.

March 31st to April 4th, 1885.—The centers were placed in position by the 10-ton derrick.

Concrete.

April 6th to 8th, 1885.—The centers were oiled, and coated with 2 batches of mortar, and 14 batches (8.82 cubic yards) of concrete were placed on them.

SPAN No. 7.

Girders.

December 18th and 22d, 1884.—The girders were placed in position between Sub-Piers Nos. 6 and 7 by the derrick "City of New York."

January 3d and 4th, 1885.—Holes were drilled in girders in which to place tie-rods to hold them in place.

Centers.

December 23d, 1884, to January 2d, 5th, and 13th, 1885.—The centers were placed by the 10-ton derrick.

Concrete.

January 2d to 13th, 1885.—The centers were oiled and the centers and girders were coated with 19 batches of mortar. 167 batches of concrete were placed between the girders.

January 14th and 15th, 1885.—The concrete was floated with 6 batches of mortar.

SPAN No. 8.

Girders.

March 6th to 9th, and 14th to 16th, 1885.—The girders were placed in position between Sub-Piers Nos. 7 and 8, by the 10-ton derrick.

Centers.

March 7th to 16th, 1885.—The centers were placed in position by the 10-ton derrick.

Concrete.

March 16th to April 1st, and 25th to 28th, 1885.—The centers were oiled, and the centers and girders were coated with 16½ batches of mortar. 141 batches (93.24 cubic yards) of concrete were placed between the girders.

Receiving Girders.

December 17th to 19th, 1884.—The piles south of the boat landing were cut off and capped, and rangers placed thereon, and decked with 4" plank to form a platform to receive the iron girders when delivered.

December 13th, 1884.—The first load of iron girders was delivered on the site of the work by A. R. Whitney & Co., under Treasurer's order No. 11,131.

January 3d to 12th, 1885.—The rest of the iron girders, tie-rods,

&c., were delivered by A. R. Whitney & Co., under Treasurer's order No. 11,131.

January 16th to 25th, 1885.—The iron girders were weighed by A. R. Whitney & Co.

February 6th, 1885.—The girders on the platform were wedged up and the tie-rods oiled.

Mooring Piles and Buoys.

July 31st and August 1st, 1884.—6 mooring piles were driven and fastened south of the Boat Landing.

August 2d, 1884.—2 concrete blocks were placed for mooring purposes by the derrick "City of New York," the divers assisting.

August 18th, 1884.—The above mentioned blocks were shifted by the derrick "City of New York," the divers assisting.

August 25th, 1884.—The mooring piles on the south side of the Boat Landing were staylathed and re-braced.

August 27th, 1884.—2 spar-buoys were placed south of the pier, for mooring purposes, by the derrick "City of New York," the divers assisting.

September 15th to 18th, 1884.—7 mooring piles were driven south of the Boat Landing and a spar-buoy placed.

November 26th to 29th, 1884.—5 mooring piles were driven.

January 24th, 1885.—The staylathing on the mooring piles south of the Boat Landing was repaired.

March 13th, 1885.—The position of the anchors and blocks used as buoys were located by the diver.

Miscellaneous.

September 29th, 1884.—The iron railing along the bulkhead wall was removed.

November 25th, 1884.—Piles were bunched, floats repaired, &c.

January 26th to 31st, 1885.—Float-stages were made.

Office, Tool House, &c.

August 30th to September 2d, 1884.—The office was moved, and a fence was built to enclose a portion of the bulkhead at the inner end of the pier.

September 9th to 12th, 1884.—The office was painted and a flagstaff erected.

November 19th, 1884.—A tool house was built.

December 1st and 2d, 1884.—The fence was extended to enlarge the enclosure.

CHAMBERS STREET SECTION.

Resolutions of the Board, November 24th, 1877, and November 21st, 1878.

Filling in Rear of the Wall.

May 13th, 1884.—A trench was dug in the new-made land to drain off the stagnant water.

June 10th, 1884.—Levels were taken over the newly-made land to measure the settlement.

July 14th, 1884.—The filling was leveled off between Duane and Jay streets, after the laying of the approach to the N. Y., L. E. and W. R. R. freight shed.

Pier Old 33, N. R.

September 11th and 12th, 1884.—The old shed south of the pier was shored up, the filling south of it having settled away.

Section Office.

June 16th, 1884.—The windows of the office were repaired.

January 5th to 30th, and February 10th to 17th, 1885.—The office was repaired and painted.

DEPARTMENT OF DOCKS.

PIER A, FOOT OF BATTERY PLACE, N. R.

OFFICE OF THE ENGINEER-IN-CHIEF,

NEW YORK, 1st May, 1886.

To the Board of Docks:

GENTLEMEN,—I have the honor to submit the following report of the work under my charge and supervision during the year ending 30th April, 1886.

NORTH RIVER.

WORK UNDER NEW PLAN.

BATTERY SECTION.—Embracing the Boat Landing, Pier A and Pier New 1, North River, and about 80 feet of Bulkhead north of Pier New 1. Some pointing of masonry joints has been done.

PIER A.—This pier has been completed, with the exception of the asphalt covering of its deck or top, upon the plan described in the last annual report, "and such buildings and structures as are necessary "for the accommodation of the business of the Department of Docks "and for the requirements of the Police Department for the harbor "police force," have been erected upon it in accordance with law.

The pier is 45 feet wide by 285 feet long. The building upon it is 42 feet wide by 272 feet 2 inches long and two stories in height. The inner 38 feet of the building is of entirely incombustible and fire-proof materials, with steel roller doors and window shutters. It is separated from the remainder of the building by a partition wall of brick 20 inches in thickness, having a 3-inch air space, and the openings through this wall have fire-proof doors. The lower story of this part of the building has in its middle the main entrance for wagons, &c., to the deck of the pier, closed by a steel roller shutter at its easterly or street end, and by a fire-proof door at the pier end, where is the fire-proof partition. On the northerly side are two rooms for the use of the Department of Police, and on the southerly side one room forming the entrance to the upper floor and offices of the Department of Docks. In the upper story of this fire-proof part of the building is the record room for the Department of Docks, 36 feet 6 inches by 41 feet, a place long needed for the safe storage and deposit for the large and constantly accumulating collection of maps and other valuable records of the Department.

The remainder of the deck or floor of the pier is occupied on the northerly side by the Department of Police, and the southerly side by the Department of Docks, and the Police Department steamer *Patrol* has the berth on the northerly side of the pier. At the outer end of the building the Police Department has a room on the lower story or deck of the pier, 15 feet by 46 feet 6 inches, and on the southerly side is the boiler room for steam-heating and a small room, the entrance to staircase leading to the top of the tower.

The building outside of the fire-proof part is a frame structure covered on the outside with galvanized iron on its sides and with tin on the roof.

The frame is composed of bents 11 feet 8 inches apart at centers, with girders to support the floor, which is of 5-inch solid spruce plank covered with one inch of yellow pine.

The side walls have under the outside covering of galvanized iron two thicknesses of tarred paper and one thickness tongued and grooved boarding. The space between the studding is filled with mineral wool. The interior is lined with wire lathing and plaster and finished in white "hard finish." Double sash windows are provided for winter use, and it was found in the severe blizzard the first few days in March that all the rooms could be kept at a temperature of 85° F., with a pressure of 60 pounds in the boiler, which is licensed to carry 100 pounds.

On the second floor are the offices of the Department of Docks, arranged on both sides of a corridor, 200 feet long and 6 feet wide, and with the Board Meeting Room at the outer end of the building, extending across its entire width.

The building is warmed by steam, lighted by gas and supplied with Croton water, a steam-pipe being carried alongside each water-pipe to prevent freezing.

On the southwesterly corner of the building is a tower 70 feet high, to be used as a lookout or watch tower by the police, access to the top being had from both floors by a spiral iron staircase.

All woodwork on the lower floor is covered with sheet iron or with wire lathing and plaster.

The building was erected under Contract No. 225, by Mr. C. O. Brown, contractor.

Under Contract No. 227, Mr. John Spence, contractor, put in all the plumbing; Messrs. Moody & Bracken, contractors, put in the gas-fitting, and Mr. Matthew Thompson, contractor, put in the steam-fitting, radiators, &c. The boiler was made by the Babcock & Wilcox Co. The offices of the Department were moved to these quarters from 12th to 19th March, 1886.

CHAMBERS STREET SECTION.—Extending from the north side of Pier Old 29 to 91, 70 feet north of the north side of Pier New 21, a distance of 651.70 feet.

Length of piling to date	670.50	feet.
" base blocks to date	603.42	"
" "E" course of granite to date	569.64	"
Equivalent length of completed wall to date	589.40	"

Some filling has been received upon this section, the section office has been painted and levels have been taken on filling in rear of wall to ascertain the rate of its settlements.

NORTH MOORE STREET SECTION.—Extending from a point 21 feet south of the south side of Pier New 26, North River, to a point half way between North Moore street and Franklin street, a distance of about 340 feet.

APPENDIX.

SUMMARY OF THE JOURNAL OF THE WORK FOR THE YEAR ENDING APRIL 30TH, 1886.

WORK OF CONSTRUCTION UNDER THE NEW PLAN.

NORTH RIVER WATER FRONT.

BATTERY SECTION.

BOAT LANDING AT BATTERY.

Pointing under Secretary's Order No. 3319.

May 1st to September 25th, 1885.—The joints in the granite of the boat landing and of the bulkhead wall south of Pier No. 1, North River, were pointed at different times during the year, when the masons were not employed on Pier "A."

PIER "A."

Resolution of the Board, July 5th, 1884.

SUB-PIER No. 1.

Granite.

May 2d to 19th, 1885.—20 pieces of granite, containing 962.97 cubic feet, were dressed and set with 6 batches of mortar and 4 batches of grout, and were backed with 8½ batches of concrete, containing 5,353 cubic yards, completing the granite for this sub-pier.

SUB-PIER No. 2.

Concrete Blocks.

May 21st to 23d, 1885.—3 concrete blocks were set by the derrick "City of New York," the divers assisting. Levels were taken on the blocks, and the joints between them were measured. In all 12 blocks, containing 219¼ cubic yards of concrete, were placed in this sub-pier.

Granite.

May 18th to June 11th, 1885.—36 pieces of granite, containing 1,722.39 cubic feet, were dressed and set with 8 batches of mortar and 3 batches of grout, and were backed with 16¼ batches of concrete, containing 10,395 cubic yards, completing the granite for this sub-pier.

July 12th to 15th, 1885.—Seats were cut in the granite to receive the iron girders.

July 11th to August 11th, 1885.—The joints in granite were pointed.

SUB-PIER No. 3.

Concrete Blocks.

May 6th to 9th, 1885.—3 concrete blocks were set by the derrick "City of New York," the divers assisting. Levels were taken on the blocks, and the joints between them were measured. In all 12 concrete blocks, containing 298.8 cubic yards, were placed in this sub-pier.

Granite.

May 9th to 30th, 1885.—36 pieces of granite, containing 1,761.94 cubic feet, were dressed and set with 10½ batches of mortar and 9½ batches of grout, and were backed with 18 batches of concrete, containing 11.34 cubic yards, completing the granite for this sub-pier.

June 1st to July 6th, 1885.—Seats were cut in granite to receive the iron girders.

SUB-PIER No. 4.

Granite.

June 22d to August 24th, 1885.—Granite joints were pointed.

SUB-PIER No. 5.

Granite.

June 30th to July 8th, 1885.—Granite joints were pointed.

SUB-PIER No. 6.

Granite.

June 20th to August 1st, 1885.—Granite joints were pointed.

SUB-PIER No. 7.

Granite.

June 18th to September 3d, 1885.—Granite joints were pointed.

Delivery of Granite.

May 4th to 7th, 1885.—The sixth and last load of granite under Treasurer's order No. 11,068 was delivered and discharged by C. Binder's Sons.

Re-cutting of Granite.

May 4th to June 10th, 1885.—The granite coping and other pieces of granite delivered for Sub-Pier No. 8 were re-cut by Department stone-cutters to make them conform to the specifications, the expense being charged to C. Binder's Sons.

SUPERSTRUCTURE.

SPAN No. 1.

Girders.

May 22d to June 20th, 1885.—Cast-iron bed plates, dipped in coal-tar, were set in mortar, in the recesses cut in coping of the bulkhead wall, to receive the inshore ends of the iron girders; the iron girders

were placed in position by the 10-ton derrick, and holes were drilled in the outer girders for additional tie-rods.

Centers.

June 3d to July 9th, 1885.—The centers were placed in position by the 10-ton derrick.

Concrete.

June 18th to September 12th, 1885.—The centers were oiled, the centers and girders were coated with 16 batches of mortar, and 153 batches (96.39 cubic yards) of concrete were placed between the girders.

SPAN No. 2.

Girders.

June 12th to 27th, 1885.—The iron girders were placed in position between Sub-Piers Nos. 1 and 2 by the 10-ton derrick.

Centers.

June 14th to 24th, 1885.—The centers were placed in position by the 10-ton derrick.

Concrete.

June 24th to July 25th, 1885.—The centers were oiled, the centers and girders were coated with 15½ batches of mortar, and 156 batches 98.28 cubic yards) of concrete were placed between the iron girders.

SPAN No. 3.

Girders.

June 20th to July 20th, 1885.—The iron girders were placed in position by the 10-ton derrick.

Centers.

June 22d to July 17th, 1885.—The centers were placed in position by the 10-ton derrick.

Concrete.

July 2d to 25th, 1885.—The centers were oiled, the centers and girders were coated with 15 batches of mortar, and 160 batches (100.80 cubic yards) of concrete were placed between the iron girders.

SPAN No. 4.

Girders.

June 4th to July 20th, 1885.—The iron girders were placed in position by the 10-ton derrick.

Centers.

June 30th to July 23d, 1885.—The centers were placed in position by the 10-ton derrick.

Concrete.

July 11th to 25th, 1885.—The centers were oiled, the centers and girders were coated with 14½ batches of mortar, and 158 batches (99.54 cubic yards) of concrete were placed between the girders.

SPAN No. 5.

Concrete.

May 25th to June 13th, 1885.—The centers were oiled, the centers and girders were coated with 15½ batches of mortar, and 161½ batches (101.745 cubic yards) of concrete were placed between the girders.

SPAN No. 6.

Centers.

May 12th to 16th, 1885.—The side centering was placed by carpenters.

Concrete.

May 11th to 23d, 1885.—The centers were oiled, the centers and girders were coated with 13 batches of mortar, and 151 batches (95.13 cubic yards) of concrete were placed between the girders.

SPAN No. 7.

Concrete.

July 1st, 1885.—The centers and girders were coated with ¾ of a batch of mortar, and 2 batches (1.26 cubic yards) of concrete were placed between the girders.

SPAN No. 8.

Concrete.

May 1st to 3d, 1885.—The centers and girders were coated with 1½ batches of mortar, and 8½ batches (5.355 cubic yards) of concrete were placed between the girders.

FLOATING OFF PIER "A."

May 1st to September 15th, 1885.—The surface of the pier was floated off with mortar so as to make a crown of 3 inches at the center. 269 batches of mortar (84.73 cubic yards) were used.

IRON MOORING POSTS.

May 1st to July 11th, 1885.—Two iron mooring posts were placed on the outer end of Sub-Pier 8.

BUOYS.

May 23d to July 7th, 1885.—Two concrete blocks, for mooring purposes, were taken up by the derrick "City of New York;" divers assisted. The spar buoys were taken up by the 10-ton derrick.

REMOVING CENTERS.

May 28th to October 25th, 1885.—The centers between the iron girders from Sub-Piers Nos. 1 to 8, inclusive, were removed.

ABUTMENT AT INNER END OF PIER.

June 12th to 17th, and August 10th to September 16th, 1885.—The

top of the bulkhead wall was rough-pointed between the north and south lines of the pier to give a bond to the concrete of Span No. 1.

In order to lessen the weight on the buttress in the bulkhead wall, upon which rest the inner ends of the two southerly girders of Span No. 1, an additional support was put in under the main girder south side of Span No. 1, and on a line with the front of building to be erected on the pier. This support consisted of an inclined I-beam, resting, at its lower end, on a cast-iron shoe bolted by divers to the first granite step below mean low water mark in the bulkhead wall, and secured at its upper end by two wrought-iron tie-rods passing horizontally through the wall, and bolted to the concrete backing of the bulkhead wall under the north side of the pier. The holes in the coping through which the tie-rods passed were drilled by steam drill furnished by Mr. T. E. Crimmins under Treasurer's order No. 11,565. After the rods were secured the whole was surrounded with concrete; 32 batches (20.16 cubic yards) were used for this purpose.

Painting Iron Work.

June 13th to September 26th, 1885.—The bottom flanges of the iron girders and the outsides of the side girders in the spans from Nos. 1 to 8, inclusive, and all other exposed iron work, was painted.

Backing Logs.

July 16th to October 16th, 1885.—605 lineal feet of backing logs were placed and fastened. Joints in the backing logs at the outer end of the pier were calked with oakum and filled up with pitch. All the counter-sunk bolt-heads were covered with pitch.

March 19th to 24th, 1885.—Scupper-holes were cut in the backing logs, and 10 lineal feet of backing logs were placed.

Fender Piles.

July 21st to November 15th, 1885.—42 white-oak fender piles were

driven, chocked and fastened, cut off at a uniform height from the deck, and the tops painted with two coats of white lead and oil.

December 3d to 12th, 1885.—Vertical wearing-pieces of oak were placed on the fender piles to protect them where the Police boat "Patrol" is berthed.

January 23d to 25th, 1886.—Put iron plates on the wearing-pieces.

February 18th to 19th, 1886.—2 white-oak fender piles were driven, chocked and fastened at the inner end of the south side of the pier, and several on the north side were wedged out further from the building on the pier.

Iron Cleats.

August 1st to 14th, 1885.—10 iron cleats were placed and fastened on the backing logs of the pier.

Angle Irons.

August 1st to 18th, 1885.—Angle irons were placed alongside of the backing logs and bolted to the concrete, to form a guard for the 3 inches of asphalt proposed to be placed over the concrete for a wearing surface for the pier.

Cleaning up the Pier.

August 20th and 21st, and September 17th, 1885.—The refuse from cleaning up the pier was placed on a scow and towed to the East Seventeenth Street Yard.

Temporary Approach.

September 3d to 4th, 1885.—A temporary plank approach was constructed to the pier.

Pointing the Under Surfaces of the Arches.

September 5th to October 26th, 1885.—After the centers were removed, the concrete arches were pointed with mortar where slight defects existed from the concrete adhering to the centers.

Silt Basins.

September 26th to 28th, 1885.—The silt basins near the approach to the pier were cleaned out.

Automatic Tide Gauge.

January 27th to 31st, 1886.—A hole was drilled through the concrete deck of Pier "A" to receive an automatic tide gauge.

Building on Pier "A."

Contract No. 225.

September 2d, 1885, to March 19th, 1886.—The following work was done under the above contract by Mr. Charles O. Brown, contractor: The brick and terra-cotta walls of the inshore or fire-proof portion of the building were built, granite caps were placed on piers to support the girders, and the iron roof trusses put up. Holes were drilled in the deck of the pier, and cast-iron shoes bolted to same for the shed posts of the wooden portion of the building to rest upon. The posts, frame and roof trusses of the wooden portion of the building were raised and properly fitted and fastened. Iron brackets were bolted to the posts and girders carrying the floor beams. The "Tower" at the outer end of the building was framed, raised and sided up; castings were placed around the arches in the doorways. Window frames with sashes and proper fittings were put up. All the rooms in the building were partitioned off, plastered on wire netting and trimmed. The ceiling, girders and sides of the lower story were plastered on wire netting. The tin roof throughout the length of the building was put on. The rolling shutters about the building were hung with the proper attachments, and the interior and exterior of the building was painted.

PLUMBING, GAS-FITTING AND STEAM-HEATING.

Under Contracts No. 227, Classes 1, 2 and 3.

Class 1. Plumbing.—Mr. John Spence, contractor.

December 7th, 1885, to February 10th, 1886.—All the plumbing for the building, including supply from street main, fixtures and connection, wastes, soil pipes, &c., was done in accordance with the specifications.

Class 2. Gas-fitting.—Messrs. Moody & Bracken, contractors.

December 4th, 1885, to February 18th, 1886.—All the gas-fitting for the building, including street connection, meters, reflectors, lamps, &c., was done in accordance with the specifications.

Class 3. Steam-heating.—Mr. Matthew Thompson, contractor.

December 15th, 1885, to March 12th, 1886.—All the steam-heating apparatus for the building, including steam mains and returns, radiators and connections, traps, boiler connections, &c., and the wrapping and boxing of certain pipes, was done in accordance with the specifications.

FITTINGS FOR BUILDING ON PIER "A."

November 23d to December 12th, 1885.—Under Treasurer's order No. 11,699, a 20-horse power boiler was placed in the building on Pier "A," with all the necessary appliances as called for, by the Babcock & Wilcox Company.

December 3d, 1885, to January 29th, 1886.—Under Treasurer's order No. 11,721, a partition in the draughting room, a window in the board room and an iron door in the brick partition wall were made and put in place by Mr. C. O. Brown.

December 15th to 24th, 1885.—Under Treasurer's order No. 11,731, the outside of the inshore end of the building was furred to receive the sheet metal covering, by Mr. C. O. Brown.

February 16th to March 18th, 1886.—Under Treasurer's order No. 11,770, iron lattice partitions were put up in the fire-proof room by Messrs. A. B. & W. T. Westervelt.

February 24th to March 11th, 1886.—Under Treasurer's order No. 11,766, closets were made and put up in various rooms by Messrs. V. J. Hedden & Sons.

February 17th to March 9th, 1886.—Under Treasurer's order No. 11,774, 267 square yards of Mosaic pavement was laid in the fire-proof room by Messrs. Martenstein, Pfaltz & Co.

March 1st to 20th, 1886.—Under Treasurer's order No. 11,797, pneumatic tubes and bells were furnished and put in place in various rooms by Messrs. C. E. Zimdar & Co.

FURNISHING OFFICES.

February 2d, 1886.—Under Treasurer's order No. 11,738, a document file cabinet, in two sections, was furnished and delivered by Messrs. Schlicht & Field.

March 8th to 12th, 1886.—Under Treasurer's order No. 11,775, 159¼ square yards of cortisine (cork carpet) were furnished and laid in the hallways of the building by Messrs. W. & J. Sloane.

February 17th to March 9th, 1886.—Under Treasurer's order No. 11,776, new gas fixtures were furnished and put up where required in the building by Messrs. Archer, Panconst & Co.

February 13th to 19th, 1886.—Under Treasurer's order No. 11,778, holland shades were furnished and placed at the windows in building by Messrs. E. J. Denning & Co.

March 1st to 9th, 1886.—Under Treasurer's order No. 11,798, the old gas-fixtures were removed from the Duane Street Office and were repaired, cleaned and put up where required in the building by Messrs. Archer, Panconst & Co.

March 20th, 1886.—Under Treasurer's order No. 11,802, Cocoa mats for the halls were furnished by Messrs. Sheppard Knapp & Co.

March 17th, 1886.—Under Treasurer's order No. 11,806, a marble slab was furnished and placed in the President's room by Mr. John Spence.

March 11th to 17th, 1886.—Under Treasurer's order No. 11,812, the Board room was carpeted by Messrs. W. & J. Sloane.

March 16th, 1886.—Under Treasurer's order No. 11,811, the President's room was carpeted by Messrs. Sheppard Knapp & Co.

March 17th, 1886.—Under Treasurer's order No. 11,818, the Treasurer's and Commissioners' rooms were carpeted by Messrs. E. J. Denning & Co.

March 27th to 29th, 1886.—Under Treasurer's order No. 11,822, the old carpets taken up at the Duane Street Office were cleaned, repaired and altered to fit the Secretary's room, and for the room of the Treasurer's clerk, by Messrs. W. & J. Sloane.

March 25th, 1886.—Under Treasurer's order No. 11,831, 12 chairs, 1 desk, 6 spittoons and 6 coat-hangers were furnished and delivered in building on Pier "A," by Mr. T. J. Sellew.

WORK DONE BY DEPARTMENT LABOR.

Building on Pier "A."

July 15th to 25th, 1885.—Excavated under the east or front line of the proposed building for the purpose of putting in concrete foundation for the brick front to rest upon.

September 11th to October 23d, 1885.—The backing logs on both sides, and at certain points on the inshore and outer ends of the pier, was reduced in width about 2 inches.

October 30th to November 2d, 1885.—Holes were drilled through the deck of the pier for the waste pipes to pass through.

January 2d to 11th, 1886.—Holes were drilled through deck of pier for water pipes to pass through.

December 22d, 1885, to January 6th, 1886.—The sheet metal on the inshore or fire-proof portion of the building was nailed on wooden

strips, secured to the soft brick of the front and sides, and the spaces thus left were filled up with mortar.

February 1st to March 15th, 1886.—The floor of the fire-proof room was floated off with mortar, and then rubbed smooth with cement stones.

February 17th to April 7th, 1886.—The rubbish about the building was cleaned up and transferred, with a small office used during the construction of Pier "A," to the East Seventeenth Street Yard. The tools, cement left over from the work, &c., were transferred to the West Fifty-seventh Street Yard.

February 14th, 1886, to March 11th, 1886.—Carpenter made and set up a base for the document file case in the room of the clerk to the Engineer-in-Chief, out of the materials furnished therefor by Messrs. V. J. Hedden & Sons, under Treasurer's order No. 11,790.

March 11th to April 30th, 1886.—Carpenters at work as required in altering and repairing furniture and fittings in the building.

April 1st to 2d, 1886.—Placed temporary wheel-guards at inner end of pier.

PIER NEW 1, N. R.

Repointing Joints in Granite.

June 6th to November 6th, 1885.—Joints in the granite were repointed where found necessary during the year, under Secretary's order No. 4,057.

CHAMBERS STREET SECTION.

Under Resolution of the Board 24th November, 1877, and November 21st, 1878.

FILLING IN REAR OF WALL.

June 23d to 25th, 1885.—28 loads of earth filling were received free, and placed to fill up rear of the bulkhead wall on the northerly slope.

September 11th to 24th, 1885.—166 loads of rough stone and brick-

DEPARTMENT OF DOCKS.

PIER A, FOOT OF BATTERY PLACE, N. R.

OFFICE OF THE ENGINEER-IN-CHIEF,

NEW YORK, 1st May, 1887.

To the Board of Docks:

GENTLEMEN,—I have the honor to submit the following report of the work under my charge and supervision during the year ending 30th April, 1887.

NORTH RIVER.

WORK UNDER NEW PLAN.

BATTERY SECTION.—Embracing the Boat Landing, Pier A and Pier New 1, North River, and about 80 feet of Bulkhead north of Pier New 1.

PIER A.—This pier has been completed, with the exception of the asphalt covering of its deck or top, upon the plan described in the Annual Report for 1885 and 1886.

Some of the iron work of the pier has been painted.

Temporary steps of wood have been placed at the door, and plans and specifications prepared and submitted to the Board for improvement of the approach to the pier and of the adjacent Boat Landing.

An additional boiler for the steam heating has also been built and put in place on the pier.

CHAMBERS STREET SECTION.—Extending from the north side

APPENDIX.

SUMMARY OF THE JOURNAL OF THE WORK FOR THE YEAR ENDING APRIL 30TH, 1887.

WORK OF CONSTRUCTION UNDER THE NEW PLAN.

NORTH RIVER WATER FRONT.

BATTERY SECTION.

PIER "A," N. R.

Under Resolution of the Board, 3d July, 1884.

Painting Iron Girders.

October 1st to 17th, 1886.—Bottom flanges of the iron girders and exposed iron work on the deck and sides of the pier were painted with two coats of metallic paint.

Steps for Building.

Under Secretary's Order No. 6121.

December 13th, 1886, to January 26th, 1887.—Temporary wooden steps and platform were made at the southerly entrance of the building, using 704 feet, B. M., of new 3-inch spruce, and 54 feet, B. M., of pine.

CHAMBERS STREET SECTION.

Under Resolution of the Board, November 24th, 1877, and November 21st, 1878.

Earth Filling.

June 25th and 26th, 1886.—A trench in the earth filling was dug north of Chambers street office to drain off the stagnant water.