

NORTH RIVER CANAL SYSTEM, LOCK NO. 4
Located in the canal path running parallel
to and on the east side of the Maury
(North) River on the west side of the
town of
Buena Vista
Rockbridge County
Virginia

HAER No. VA-61-C

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Northeast Region
U.S. Custom House
200 Chestnut Street
Philadelphia, PA 19106

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HISTORIC AMERICAN ENGINEERING RECORD

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Location: Located in the canal path running parallel to and on the east side of the Maury (North) River on the west side of the town of Buena Vista, Rockbridge County, Virginia.

UTM: Lock Four 17.643840.4176160

Quad: Buena Vista, Virginia

Date of Construction: ca. 1857

Present Owner: CSX Transportation, Inc.
Real Estate Division
500 Water Street, SC J350
Jacksonville, Florida 32203

Present Use: Lock 4 was abandoned when the canal went into disuse. Lock 4 has for some time been used as a trash dump.

Significance: The North River Navigation represents a rare example of stone lock construction in Virginia, exhibiting remarkable similarities to earlier structures of the Potomac Canal at Great Falls, Virginia. It was, moreover, an unusually late example of canal building, erected in an era when these systems were being rapidly superseded by railroads.

Part of a state-sponsored project to connect the James and Ohio Rivers, the canal extended navigation northward from the James River to Lexington, Virginia, transforming the area's economy. Furthermore, the presence of the canal seems to have been an important factor in determining the trajectory of the railroad which, in the 1880s, superseded it, incorporating the old path towpath and aqueduct abutments in its construction.

It was over the North River Navigation that General Stonewall Jackson's body was conveyed after his death in May of 1863 from wounds received at the Battle of Chancellorsville. One of the best preserved canal systems in the state, these features reveals much about lock and aqueduct construction seen only in fragments elsewhere. Additionally, the technology used here is much the same as that found more than a half century earlier and attests to the soundness of design adopted by early canal engineers in Virginia.

Project Information: This documentation was undertaken in 1991 in accordance with the Memorandum of Agreement by the Army Corps of Engineers, Norfolk District, to mitigate the affects of the Buena Vista floodwall/levee project. Charles M. Downing was responsible for the historical research, and Donald W. Linebaugh provided administrative oversight. Downing and Linebaugh are employees of the Center for Archaeological Research, College of William and Mary. Willie Graham and Mark R. Wenger, consultants to the Center for

Archaeological Research, undertook the physical analysis, recordation, and photographic documentation of the canal system. The Center for Archaeological Research subcontracted with Telemark, Inc. to perform this work for the Corps of Engineers.

Donald W. Linebaugh
Co-Director
College of William and Mary
Center for Archaeological Research
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Lock No. 4, located 6400 feet downstream from the Ben Salem Lock and 1000 feet north of Lock No. 5, provided eight feet of lift along this stretch of the North River Canal system. The lock is located at the southwest end of town just east of the Maury River. Before the canal was replaced in the late 19th century with a rail line, it provided Lexington with a direct transportation link to the James River. Since that time the canal has silted in, Lock No. 4 has been used as a trash dump, and the tow path was appropriated as the base for a rail bed. Trees and wild shrubs have overtaken much of the canal. With the assistance of equipment operators from the city of Buena Vista, Lock No. 4 was sufficiently cleared of vegetation and debris to reveal its general form. Of the three extant locks in this vicinity it is the least complete. To understand this ruin, it has been necessary to rely on information gleaned from the other nearby features.

Fabrication started on the canal in 1851. Edward Lorraine, the chief engineer for the North River Navigation Company (NRNC), made a report in 1857 on the progress of construction, noting that mechanical work had been completed on this lock. In fact, by this time much work along a 2.69 mile stretch of canal in the Buena Vista vicinity was well underway (Lorraine 1857:374).

A portion of the contract specifications likely drawn up by the James River and Kanawha Canal Company (JR&K) survives, giving a distinct picture of the character the locks were to assume (JR&K 1859:1-3) (see Appendix B). Because this document is undated it is unclear whether it preceded any construction along the North River Canal or was drafted when the JR&K took control of the project in 1857. If the document is from this latter period it post-dates the construction of Locks Three, Four and Five. Nonetheless, there is a striking similarity between the specifications and the existing locks.

This document required that, if bedrock was not available for footings, then 12- by 12-inch beams were to be laid on top of two-inch thick sheet pilings driven four feet into the ground. The specified lumber was white oak, pine, or "such other sound and durable timber, as the Engineer will approve". These foundation sills seem to have run perpendicular to the length of the lock. After filling in the gaps between these members with gravel, two-inch thick planks were to be laid tight forming a floor for the lock bed. This floor was optionally secured with either spikes or 1 1/4-inch pegs (locust or white oak "treenails"), while no choice but iron spikes was given for the top layer (JR&K 1859:1).

On top of the first layer of flooring the "main" and "mitre" sills were laid. The main sills ran parallel to the foundation sills, while the miter sills ran perpendicular. The miter sills were placed at the base of the gates for which they likely served as stops (Garrett 1987:747). The main sills were to extend nine inches into the masonry walls on each side. Between these sills, an upper layer of planks was to be laid directly on the bottom flooring to form a water-tight seal (JR&K 1859:2).

Once the framing was in place, the masonry walls could then be raised. Uncoursed rubble was to be used for the backing of the walls. The only tooling required was hammer-dressing to allow for close seating of the stones. The "main walls" were to be four-feet thick at the peak with their interior exposed face plumb and "generally batter[ed] on the back three inches to one foot." The two "wing walls" (the ends where water enters and exits the locks) were specified to be curved with a four-foot radius, forming a perpendicular projection to the main walls (JR&K 1859:1-2).

The "lock chamber"--that portion of the lock between the gates--was designated to be 15-feet wide and 100-feet long. The face and coping stones of the chamber walls, the lower gate rebates, and the lower wing walls were to be hammer-dressed on the face above the water line of the downstream level. Particular care was to be taken in dressing these face stones to remove projections on which boats could catch. Less finishing was required for the remainder of the face stones. Leveling stones of less than four inches were forbidden along the entire length of the lock, probably to ensure that they did not work loose, posing a safety threat. Along with the requirement to have a dressed face and rubble backing, the walls were to be bonded "throughout their extent and thickness, by a system of headers and stretchers." The stones were to be laid in a "full bed of good well

worked mortar" and the joints were to "be grouted, and afterwards filled with broken stone well rammed in" (JR&K 1859:1-2).

Two special wall conditions were described. In the first of these, "hollow quoins" formed a curved rebate into which the gates were to fit. These stones were to "be of good sound stone, not less than twelve inches thick the curve part to be cut perfectly smooth. There are to be alternate headers and stretchers" (JR&K 1859:2).

The second condition was described as a "breast wall" to hold back the bed of the upper section of the canal from eroding into the lower floor. Instead of bonding this into the main walls, a four- by four-inch vertical slot extending up to about eight feet shy of the coping was to be cut into the main walls. This occurred immediately upstream of the rebate for the upper gates. Presumably, the purpose of the slot was to carry oak planks that served as a retaining wall to the breast wall, thus holding it in place against the force of the upstream canal bed (JR&K 1859:2).

Finally, the specifications included some detailed drawings. The contractor was to be responsible for providing additional drawings, but neither set appears to have survived (JR&K 1859:2).

Though Lock No. 4 conforms generally to these specifications, there are a number of minor differences. In addition, there are subtle variations among the extant locks, suggesting that different hands were involved in their respective fabrication. As Charles Downing has indicated in the narrative history of the site earlier in this report, contracts for construction of the various canal features initially were let to owners of the adjoining properties. This apparently led to shoddy and inconsistent workmanship and may have resulted in the insistence on specifications by the JR&K (Trout 1966:6,9).

Contrary to the wooden locks of smaller scale proposed by the NRNC stockholders, stone structures of the scale used on the James River and Kanawha canals were constructed. Lock No. 4 measures 135 feet in total length, resulting in a chamber of approximately 99 feet, between the gates. This assumes that the lower gates were located in the same position relative to the wing wall, as were those in Lock No. 5. The width of the channel is 15'-6" and the rebates for the gates measure 1'-4" in depth. These dimensions closely approximate those listed the specifications.

The walls of Lock No. 4 were built of rubble with a facing of locally-quarried, dressed, yellowish-gray limestone with quartz veining, and was roughly coursed as can be seen in construction of the Indian Gap Run and Pedlar Gap aqueducts. The quality of this tooling is generally better than that in Lock No. 5. Moreover, the stones are well-tooled over the entire facing of the lock, contrasting with the specifications which called for well-dressed surfaces only in the lower ends of the locks and above the waterline. To maintain coursing, the mason occasionally cut the bottom of his stone to accommodate projecting corners in the course below. In some instances, slate and limestone shims were used as well, a violation of the requirements. All of this work was laid and then pointed with a yellow/buff mortar of medium hardness, possibly the hydraulic cement championed by Ruff. No oyster shell or sizable chunks of lime are visible in this material.

There were once gates at both ends of the lock. At either end, the wing walls were rounded so as to minimize damage from boats passing through the lock. On Lock No. 4, there are slots on both sides of the entry, extending about half way up the height of the stonework. These are clearly the rebates mentioned in association with the breast wall specification and may have secured timber planking to stabilize the bottom of the canal where it met the lock.

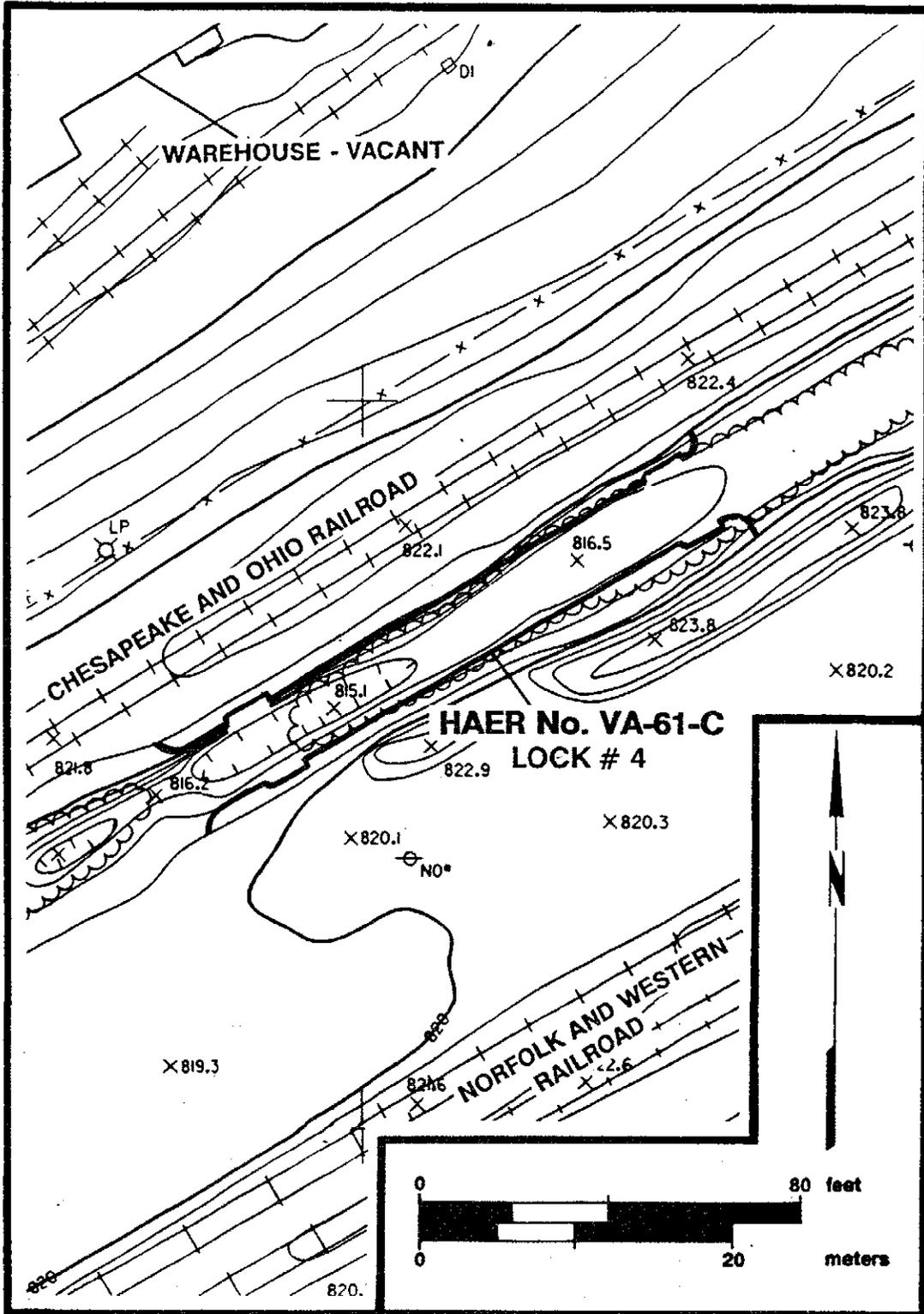
On the upstream end of the structure, "hollow quoins" or stone haunches for the upper gates survive on both sides. At the hinge points of these gates, iron straps were let down into the top faces of the coping stones, and were secured by running nuts down on threaded iron rods set in lead. These straps seem to have carried an eye to engage an upper pintle on the lock gate. Some receptacle for a lower pintle was surely

provided as well--possibly a drilled out stone or some sort of casting seated in a stone. These features all relate closely to surviving elements of the Potomac Canal at Matildaville, Virginia, completed about 1790. Judging from these similarities, it is likely that the gates, when closed, formed a kind of wedge, pointing upstream. In this position, the pressure of the higher water above the lock held the gates firmly shut, pushing them back into the stone quoining behind. This pressure was relieved by opening a sluice at the bottom of the gates. When opened, the gates swung upstream into deep rebates in the side walls to maintain the full clearance of the lock interior (Garrett 1987:751-753; Trout 1983:3-6).

The downstream end of the lock is entirely gone, but the remains of the Ben Salem Lock and Lock No. 5 indicate that a similar arrangement existed at this end. Here too, the gates opened upstream, folding into the rebated sides of the lock. Between the two gates only the rubble wall on the north side of the lock survives; the facing stones having all been pulled away. Evidently, facing stones did not bond through as called for in the construction documents. Because the lower portion of the lock remains buried, it is impossible to determine the nature of the substructure. However, the framing system described in the specifications bears a close resemblance to that used for the bridging of the Indian Gap Run and Pedlar Gap Run aqueducts. It is therefore quite possible that the framing was similar to what was specified.

The North River Canal system was damaged during the Civil War and by two floods--one in 1870 and one in 1877. By the time the railroad was introduced to the area in the early 1880s, portions of the canal seem to have been dysfunctional, and the canal itself was soon abandoned.

Site Plan



SPECIFICATION

*For a Lock of Mortared Ruble Masonry on the
the North River Navigation Improvement, On Section, No.*

division of

EXCAVATION OF THE PIT.

The excavation of the pit for the lock shall be of such length, width and depth, and with such slopes as shall in the opinion of the Engineer, be considered necessary, as well for the security of the work by puddling after it shall have been finished, as for a space sufficient for the work during the construction. After the excavation of the Pit, the bottom shall be prepared in such manner as the Engineer may direct, so that the timber may be properly hedged.

Any stone excavated from the lock pit, if approved of by the Engineer, may be used in the lock without charge. All other material, whether of rock or of earth, shall be deposited at any place the Engineer may direct, not exceeding two hundred feet from the pit; and if placed in the embankments of the canal, in the manner required by the Section Specifications,, the extra labour caused thereby shall be paid for at the estimate of the Engineer.

The Company reserve the right of causing the Contractor for any of the neighbouring embankment to excavate the pit with a view to the material being used to that embankment. They also reserve the right of making a contract with any person at any time during the construction of the lock, for puddling up and embanking around the masonry, or they may do this with hands hired and paid by the Company. Unless the Company see fit to exercise this reserved right, and until they shall do so, the Contractor shall carry on the puddling and embankment as directed by the Engineer, so that at no time shall any portion of it be nearer than two feet to the level of the lowest part of the masonry that may at such time be laid and grouted.

FOUNDATION.

If a rock foundation cannot be had, the lock shall be placed on a bottom formed of one foot square, white oak, Pine, or such other sound and durable timber, as the Engineer will approve, laid at right angles to the axis of the Lock, the middle of each timber being placed exactly in the line of the centre of the Lock. These timbers shall be laid five in number, and under each of the Mitre Sills, shall be well counter hewed on the sides and laid close together, as shown in the drawing.

The timbers shall rest on a bed of good gravel puddle, into which they shall be driven at least one inch, and the spaces between the timbers shall be filled with gravel, or other suitable material, as the Engineer may designate, which shall be rammed or packed.

There shall be at least three rows of sheet piling running across the foundation, to be composed of well jointed, two inch pine, or white oak plank, and to penetrate, at least four feet below the foundation timbers, to be driven or placed in trenches and filled and secured, all as may be directed by the Engineer.

After the foundation timbers are all laid and made perfectly level, a floor to be composed of sound two inch pine or white oak plank, free from shakes, well jointed both at the side and ends, shall be laid over the entire foundation of timber and be secured to it by one five inch spike at the crossing and two in the ends, driven through each plank, into each of the timbers, it shall be secured by two spikes seven inches long, in each end of each plank, and one seven inch spike driven through each plank into each timber. Locust or white oak trenails eight inches long and to fill a one and a quarter inch bore, may be substituted for spikes in the first or lower course of planking.

DIMENSIONS.

The Lock Chamber shall be fifteen feet wide, one hundred feet in length, between the upper sides of the two main sills. The face of the upper wing shall be fifteen feet from the upper side of the upper main sill, and the faces of the lower wings shall be eighteen feet from the upper side of the lower main sill, but they shall be arranged in any manner the Engineer may prescribe.

The recesses shall be sixteen inches deep, and extend ten feet above the upper sides of the main sills.

The main walls of the Lock shall rise to the height of one foot above the water surface of the upper level. The height, as also the height of the wings shall be _____ feet from the top of the first course of planking to the top of the copings; and the top of the first course of planking shall be ten inches below the bottom of the Canal. The main wall shall be four feet thick at top; they shall be vertical on the face and generally batter on the back three inches to one foot. The upper and lower wing wall shall run out at right angles to the line of the Lock, and extend _____ feet from the face of the main walls, with which they shall be connected by curves of four feet Radius.

MASONRY.

The Masonry is to be of the kind usually denominated rubble, that is to say, it will not be required to be regularly coursed. The bed and joints of the stones shall be dressed, however, with the hammer, when necessary, in order to give them a good bearing. None of the face stones shall have less than twelve inches depth of bed, nor be less than two feet long, and they shall be of the same thickness at the back and face, which is not to be less than eight inches.

The face stones of the Chamber, lower recesses, and lower wing walls, from the Lower Quoins down to and around the curve, shall be Hammer dressed on the Face, above the water line of the lower level, sufficiently to leave no projections, upon which a boat can catch or hang--the face stones of the upper recesses and wings shall be dressed in the same manner above the top water line of the upper level. The remainder of the face shall be brought to a fair line of pointing off projections. No levellers of less than four inches in thickness shall be used in the facework and these only when absolutely necessary in changing from a higher to a lower course, changes in the courses of less than four inches in height must be made by checking out of the higher courses. The end joints, both of the face and backing shall overlap at least eight inches.

The wall shall be well and thoroughly bounded throughout their extent and thickness by a system of headers and stretchers laid in such manner as to break joints with each other and tie every part of the masonry together. The masonry shall be formed of good large, solid stone, well shaped and laid close. No small stones shall be used in the backing except when necessary to level up work and to fill the interstices, as shall be approved by the Engineer.

Headers of nearly a uniform thickness and breadth, throughout their entire length, which shall not be less than three feet six inches, shall extend into the wall, both from the face and back, at least every ten feet in each foot of the height of the wall. These headers shall be so arranged that the headers in each successive irregular course will be placed over the space between the headers in the course beneath, other large, well shaped stones shall be placed along side of the headers in such manner as to break joints and to tie the wall from front to back--these stones shall extend beyond the ends of the headers and lap on each ten inches at least.

All the stones shall be well laid in full bed of good well worked mortar, and the joints shall be well grouted, and afterwards filled with broken stone well rammed in.

BREAST WALL.

The breast wall shall be of masonry, similar to that prescribed for the main walls. The thickness shall be three feet at top and five at bottom. The top of it shall be five feet eight inches below the surface water of the upper level, and it shall be coped with three inch oak plank jointed and fastened to two timbers let into the wall with two spikes eight inches long in each end of each plank.

There shall be a groove for stop plank four inches wide and four inches deep cut in the face stone of the upper Lock at one foot above the recess corner rising from the coping of the Breast Wall, to within eight of the top of the Lock Walls.

The back of the Wall shall be so laid as to present a fair and even surface on the Rear.

The whole face of the work is to be neatly pointed and drawn in Fine Mortar as each corner is finished.

DRY WALLS.

Dry walls will be built at each end of the lock and also a paving below the lock, when necessary. The dimensions of these dry walls and of the paving shall be such as the Engineer may prescribe. The contractor for the Lock may be required to build these dry walls at the head and foot of the lock and the paving below it, but the company reserve the right to let either of these items to any other person, either before or after the completion of the Lock.

HOLLOW QUOINS.

The hollow quoins shall be of good sound stone, not less than twelve inches thick the curve part to be cut perfectly smooth. They are to be alternate headers and stretchers. The first hollow quoin, shall form all the curves and extend 20 inches below the nose of the Quoins, besides and have three feet bed measured from the recess. The next hollow quoin shall extend nine inches above and nine below the preceding one and have eighteen inches bed measured from the recess. The remaining hollow quoins shall take alternately the preceding positions, and have at least the above bend in the wall.

MITRE SILLS.

The mitre sills and main sills shall be of first rate white oak timber, ten by fifteen inches well planed, and put together in a workmanlike manner. They shall be laid immediately upon the first course of planking over the bottom of the lock, which shall be well planed to receive them. Each mitre sill shall be bolted to the foundation timbers by twelve iron bolts, twenty-two inches long, one inch square and ragged at the points and in addition thereto secured by trenails as the Engineer may direct.

The main sills shall extend at least nine inches into the wall on each side, and be fitted into cheeks in the masonry, well out and prepared to receive them.

LOCK GATES.

The company reserve the right to make a separate contract for the construction and fixing of the Lock Gates, but especial care will be required that the hollow quoins be truly cut so that no trimming will be necessary for the gate contractor.

COPING.

The coping shall be formed of good sound flags not less than nine feet in superficial area, and not less than eight inches thick. The hollow quoin coping shall not be less than twenty feet in superficial area. And one foot in thickness. The end joints of the coping to be scabbled, so as not to exceed one inch wide and the face and top to be dressed to correspond with the dressing of the face work above the water line the beds are not to be less than two and a half feet wide.

MATERIALS.

If the contractor cannot agree with the proprietor of the quarry or quarries whence the stone for the lock is to be obtained for the value of the same, the President and Directors will upon application cause the same to be condemned, according to the charter of the company, the contractor paying expenses of the condemnation, including damages assessed.

DRAWINGS.

Drawings of _____ shall be furnished the contractor, and all necessary explanations shall be given by the Engineer. Every part of the work shall be executed in strict conformity to the drawings and directions of the Engineer. There shall be any changes from the above specification in plan and dimensions that the Engineer shall consider necessary and direct the quantities in case of such change shall be altered so as in every case to give the exact amount of masonry, &c.

CEMENT AND SAND.

The cement shall be furnished by the Company, and shall be taken by the Contractor for the lock from some one of the deposits of cement which shall be established by the Company, upon the written order which he shall from time to time receive from the Engineer for the same, and the Engineer shall be the sole judge as to which deposit it shall be drawn from, and shall express the same in said order. And the said Contractor shall transport the cement so received to said work in good tight barrels, casks or bags, to be provided by him at his own cost, and shall keep it secured from the weather while being transported and, until used, he shall provide a suitable cement house, built at his own cost under the direction and subject to the approval of the Engineer; but the Company shall pay the Contractor upon the completion of the lock, three-fourths of a cent per bushel per mile for every hushel of cement transported by him in good order and actually used in his contract.

On presenting the written order of the Engineer and receiving the cement, the Contractor, his agent or boatman shall apply to the Company's agent from whom he received it, for a certificate of the quantity and quality of the cement which may be delivered to him which certificates shall be presented to the Engineer on the arrival of the cement at the place where it is to be used; and it shall be the duty of the Engineer to examine and compare the cement delivered there with that which the certificate calls for.

No cement shall be used in the work which shall have been damaged on its passage from the mill, depot, or kilns, or while in the possession of the Contractor. And in the event of any cement being so damaged, the loss of the same shall be sustained by the Contractor.

It is expressly stipulated, that although the Canal Company agree to furnish the cement for the locks, yet if from any cause the said Com. shall not be able to supply it as required, they shall not be responsible for any damages arising to the Contractor from the want of the same.

The sand must be clean and sharp, and if deemed necessary it must be washed. A sufficiently large screen shall be procured by the Contractor, through which he shall pass the sand, the meshes of which shall not exceed one quarter of an inch.

The cement shall be mixed in such proportions with the sand as the Engineer shall from time to time designate, but in no instance shall these proportions be less than one measure of cement to one of sand.

The mortar shall be properly worked upon an approved bed formed of plank, and the length of time between the first wetting of the cement and its being placed in the wall shall not exceed fifteen minutes.

The grout shall be formed of cement and sand mixed in the same proportion as the mortar, & no longer time shall elapse between the setting of the cement and its use than in the case of mortar, viz: fifteen minutes. The grout box shall not contain when full more than twenty-four cubic feet.

The Contractor shall not employ any workman or labourer who has been discharged by any other Contractor for improper or disorderly conduct, or for violation of the preceding articles.

The Contractor shall be at all risque from the rising of the river and from floods therein.
No extra allowance will be made for pumping or bailing water.

PROPOSAL .

I propose to furnish all the necessary materials, and construct _____ on the
_____ division of the North River Navigation Improvement, and do all the necessary excavation
embankment and puddling, in conformity to the foregoing specification, for the following prices:

LOCK .

For all mortared masonry, including all other materials laid in the lock, _____ Cts.
except cement, per cubic yard,

For all gravel spread over the bottom of the pit and all puddling,
per cubic yard,

For the mitre sills, including framing, preparing, and placing securely in the
proper position per linear foot,

For all iron bolts per pound

For all plank and boards used in the flooring and sheet piling, per 1000 feet,
board measure, including workmanship, spikes, and trenails,

For all square timber in the foundation including workmanship, per linear foot,

Excavation of rock quarried or blasted, per cubic yard

Excavation of slate per cubic yard,

Excavation of all other materials, to include Detached Rock of less, than
one half a cubic yard in content, per cubic yard,

For all dry walling, per cubic yard,

For paving below the Lock, per cubic yard,

For all embankment for Lock the material not transported more than 120 feet,
per cubic yard,

For same materials transported over 120 feet, per cubic yard.

For all riprap, per cubic yard,

Work to be commenced within days from this date