

**REPORTS ON THE CONSTRUCTION OF
THE PIERS OF THE AQUEDUCT OF THE
ALEXANDRIA CANAL ACROSS THE
POTOMAC RIVER AT GEORGETOWN,
DISTRICT OF COLUMBIA, PP. 5-47**

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Reports on the Construction of the Piers of the Aqueduct of the Alexandria Canal Across the Potomac River at Georgetown, District of Columbia, pp. 5-47 by William Turnbull

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WILLIAM TURNBULL

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ENGINEER DEPARTMENT, UNITED STATES ARMY.

REPORTS ON THE CONSTRUCTION

OF

THE PIERS OF THE AQUEDUCT

OF

THE ALEXANDRIA CANAL

ACROSS

THE POTOMAC RIVER AT GEORGETOWN, DISTRICT OF COLUMBIA

BY

WILLIAM TURNBULL,

MAJOR CORPS TOPOGRAPHICAL ENGINEERS, UNITED STATES ARMY.

1835—1840.

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1873.

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
Washington, D. C., December 31, 1872.

SIR: The reports of the progress of the construction of the piers of the aqueduct of the Alexandria Canal across the Potomac, at Georgetown, made from time to time to the Chief of the Corps of Topographical Engineers by the engineer in charge, Major Turnbull, were printed by Congress in 1838 and 1841, with accompanying drawings. They have been called for on several occasions by persons engaged in similar undertakings; but there are no copies remaining on the files of this Office for distribution. They are of special interest to the engineer on account of the unusual depth of foundations and the difficulties encountered in establishing them.

I would suggest the propriety of reprinting, by the Public Printer, such portions of these reports as are of special interest for the use of the Corps of Engineers.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Brigadier-General and Chief of Engineers.

Hon. W. W. BELKNAP,
Secretary of War.

Approved by the Secretary of War.
JANUARY 3, 1873.

POTOMAC AQUEDUCT.

REPORT ON THE CONSTRUCTION OF THE POTOMAC AQUEDUCT, BY WILLIAM TURN-
BULL, MAJOR UNITED STATES TOPOGRAPHICAL ENGINEERS.

POTOMAC AQUEDUCT, *January 1, 1836.*

SIR: I have the honor to report that, immediately on the receipt of your order of the 29th of August, 1832, concerning the Potomac aqueduct, I communicated the same to T. F. Mason, esq., the president of the Alexandria Canal Company; and I soon after made the necessary examinations to enable me to determine the proper position of, the extent, character, and cost of the work. By these surveys were ascertained the depth of the river from the plane of high water to the muddy bottom, and the depth and nature of the deposit beneath the river to the solid rock which underlies it; the direction and probable velocities of the current, and the length and direction of the aqueduct, and of its abutments and embankments; the quantity of excavation necessary to carry the masonry to a solid foundation, and the strength which should be given to the structure to enable it to resist the pressure of the ice and other floating matter which is carried down by the freshets of the river.

The site of the aqueduct had been already fixed, in 1829, by Messrs. Wright and Roberts, engineers of the Chesapeake and Ohio Canal Company, as may be seen by their report of that year. Among the drawings which accompany their report there is one which would seem to be a profile of the river, and to exhibit the depth of water and the mud beneath; but in their report they state that after the first sounding, which they made 50 feet from the shore, the iron rod which they had prepared themselves with for penetrating the mud was lost, and they think it safe to estimate the depth of mud from 3 to 5 feet for the remainder of the distance, (1,530 feet;) an estimate which, it will be seen hereafter, is very far from the truth.

My survey of the river shows a line shorter than theirs, and at the same time exactly at right angles to the thread of the stream, and nearly in continuation of one of the streets of Georgetown.

Influenced by the decided superiority of this line over that selected by Messrs. Wright and Roberts, and coinciding in this opinion with Mr. Fairfax, the engineer of the Alexandria Canal Company, with whom I at that period acted, we applied to the mayor of Georgetown for the consent of that corporation to use that street as the northern abutment of the aqueduct, and we suggested to him the idea that it might be of advantage to the town to unite with the Alexandrians in constructing a roadway upon the piers of the aqueduct. This suggestion met with the decided approbation of the mayor, and he referred the subject to the councils, each branch of which appointed a committee to

confer with the engineers; but the subject was not acted upon by those gentlemen. Six or eight months thereafter, however, when it became necessary to lay off the work for the contractors, they were induced, by the earnest solicitation of a gentleman of Georgetown, to meet the engineers on the ground. They were then unanimous in consenting to our using the street next west of the one designated by us; but not having power to act definitively, the matter was again referred to the councils, which took no further steps in the matter; and we were therefore necessitated to fix the abutment upon the site designated by Messrs. Wright and Roberts.

I narrate these facts that professional men commenting upon the position of the axis of the aqueduct, which is oblique to the stream, may be informed that neither Mr. Fairfax nor myself had any agency whatever in placing it where it is, but that, on the contrary, we were compelled, by circumstances beyond our control, to adopt it.

The borings for the foundations were conducted after the method by which the main or framing piles of the coffer-dam for the tide-lock at the western termination of the Caledonia Canal were fixed to the rock, only that we used a square box instead of a cylindrical one; that is to say, the box was formed of 3-inch heart pine-plank, 36 feet long, 8 inches in the clear inside, well jointed and banded with flat iron bars; the lower end of the box was shod with flat iron shoes, edged with steel, and fitted on the end of each plank, to prevent its being damaged by stones while driven to the rock; it was then driven in the ordinary manner of driving a pile, as far as it could be driven without crushing. It was then emptied by means of an auger made in the form of a quadrant of a circle, of the same diameter as the inside of the box; the circular side and one of the straight sides of this quadrant, for 18 inches of height, were made close, of thin rolled iron riveted to the ribs, which were fastened to the corners of the quadrant; from this proceeded an upright shaft, the other straight side being open to the bottom of it. Four flat teeth, each $2\frac{1}{2}$ inches long, were fixed with an inclination downward, so that when the auger turned, these teeth loosened the sand and prepared it to enter easily into the body of the auger. To keep it steady while turning, there was fastened to the lower side of that corner of the quadrant which is the center of the circle, a pivot 6 inches long, which passed into the sand, and served as a center for the auger to turn upon. Immediately above this pivot stood the upright shafts, made of inch-square bars of iron, capable of being joined by male and female screws, 5 and 10 feet long, to any required length; upon this two cross-handles were placed to turn it with. A scaffold was erected by spiking strong pieces of timber to the deck of the pile-driver scow, their ends extending beyond the planks; planks were laid across these for a platform, upon which four men stood to turn the auger. From four to six turns, according to the nature of the stratum through which it had to pass, filled it. It was lifted above the top of the box by a purchase acting from the top of the pile-driver, and the sand was then cleaned out with a small shovel by a man standing upon the scaffold. At all the borings but one, where a stratum of coarse gravel 2 feet above the rock occurred, the box was driven to within a few inches of the rock; and in all cases where the box was emptied, a sounding-rod of iron, one inch in diameter, was dropped into it, which, rebounding several feet, proved that the solid rock had been reached.

At the point where the gravel occurred, about three-fourths of the way across the

river, reckoning from the north side, the first attempt to reach the rock was ineffectual, the gravel caving in under the foot of the box as the auger was withdrawn; and as the box was required for other borings, it was thought unsafe to risk driving it through the gravel until the others were completed; but when they were, the box was brought back to the gravel-bank, and driven with great force until it began to spring or burst, although it had not yet entirely penetrated the gravel; it was, however, emptied to the foot, and a sounding-rod of iron was forced through the remainder of the gravel to the rock.

The box was always drawn by the crank of the pile-driver, with the assistance of double and single purchase-blocks. The number of borings were so multiplied as to prove the existence of rock under the entire bed of the river, at an average depth of 28 feet (instead of 15 feet as estimated by Messrs. Wright and Roberts) below the surface of ordinary high-water mark.

With the data thus obtained, a profile of the river was constructed, exhibiting the depth of water and mud to the rock.

The subject which next claimed the attention of the engineers was a plan for the proposed work. Having no instructions on this point, we were left entirely to the guidance of our own judgment, and to the influence of the facts which my survey and examinations of the site of the work had brought to view, and these were such as to induce us to give to the plan a character of the utmost stability as it respected the foundations, and one of equal durability to the superstructure.

It was to consist of twelve arches of stone, supported by eleven piers and two abutments; the arches to be 100 feet span and 25 feet rise; the soffits to be curves of eleven centers; three abutment-piers, being every third pier, to be each 21 feet thick at the springing of the arch; and eight piers of support, each to be 12 feet thick at the springing, the masonry of the land-abutments to be 21 feet thick. This plan was approved of by the president and directors, with the exception of the superstructure, the cost of which, being beyond the limited means of the company, was left for after consideration. The plan was further altered by rejecting the abutment-piers; but eventually those were restored on the recommendation of the engineers. A causeway of earth, 350 feet in length, was substituted for three of the arches at the southern extremity of the work.

The adoption of the causeway made a change in the arrangement of the piers necessary; and it was then decided that the aqueduct should consist of eight piers, 105 feet apart at high-water mark; two of them to be abutment-piers, each 21 feet thick, and six of them piers of support, to be each 12 feet thick, at high-water mark. The southern abutment to be 21 feet thick, with circular wing-walls, 13 feet average thickness at the base, 66 feet in length on each side, to connect with the slope-walls of the causeway. (See plate 1.)

The northern abutment, which is to be built by the Chesapeake and Ohio Canal Company, is not yet decided upon. Each of the piers to have an ice-breaker upon the upstream end, in form of an oblique cone, sloping forty-five degrees, extending 5 feet below, and 10 feet above, high-water mark, made of cut granite; the down-stream ends to be circular, and to have a batter or slope, the same as the sides, one inch to the foot. Upon this plan the work has been commenced, and so far progressed.

On the 29th of January, 1833, by the order of the board of directors, the engineer