

Z 8.

IMPROVEMENT OF TWO RIVERS HARBOR, WISCONSIN.

Original estimate, 1870 .....	\$265,588 80
Appropriated since .....	140,000 00
Leaving to be appropriated .....	125,588 80
Amount which can profitably be expended in fiscal year 1880-'81 .....	60,000 00

The work in progress during the past year has been the construction of a sand-tight lining to the pile-piers, and a fence to prevent the sand from drifting into the channel. The permeable character of pile-piers and the necessity of making them sand-tight, is a problem presented at a large number of harbors; various methods have been suggested or adopted, the values of which can be determined only by experiment and experience. In consideration of this, and the added difficulty of clearly specifying beforehand the work to be done, it was undertaken at this harbor by hired labor and the purchase of materials in open market.

The lining consisted of sheet-piling of oak plank 3 inches thick and 18 feet in length, of which 13 feet was below and 5 feet above water surface, their upper ends being in the plane of the top of the superstructure, to which they were secured by two oak wales 6 inches by 12 inches, one at the water surface, the other at the top of the superstructure. Upon the work outside of the shore-line the sheet-piling was of two thicknesses, breaking joints. To obtain a sand-tight lining it was necessary that the sheet-piling be vertically placed and in close contact. The depth to which they had to be sunk in the sand was from 5 to 11 feet, and ordinary methods of driving would have failed to place them; instead thereof the water-jet, as an auxiliary to the pile-driver, was most successfully employed. Subsequently, Mr. R. S. Littlefield, an assistant engineer in the United States Engineer service at Chicago, claimed the method used to be an infringement on a patent previously granted him. \* \* \* \*

The fence built was 354 feet in length and 8 feet high. The cost was \$56.14, or 15.8 cents per linear foot.

Riprap was placed along 250 feet of the channel side of the south pier; 17 cords of stone were thus placed, at a cost for handling of \$10.

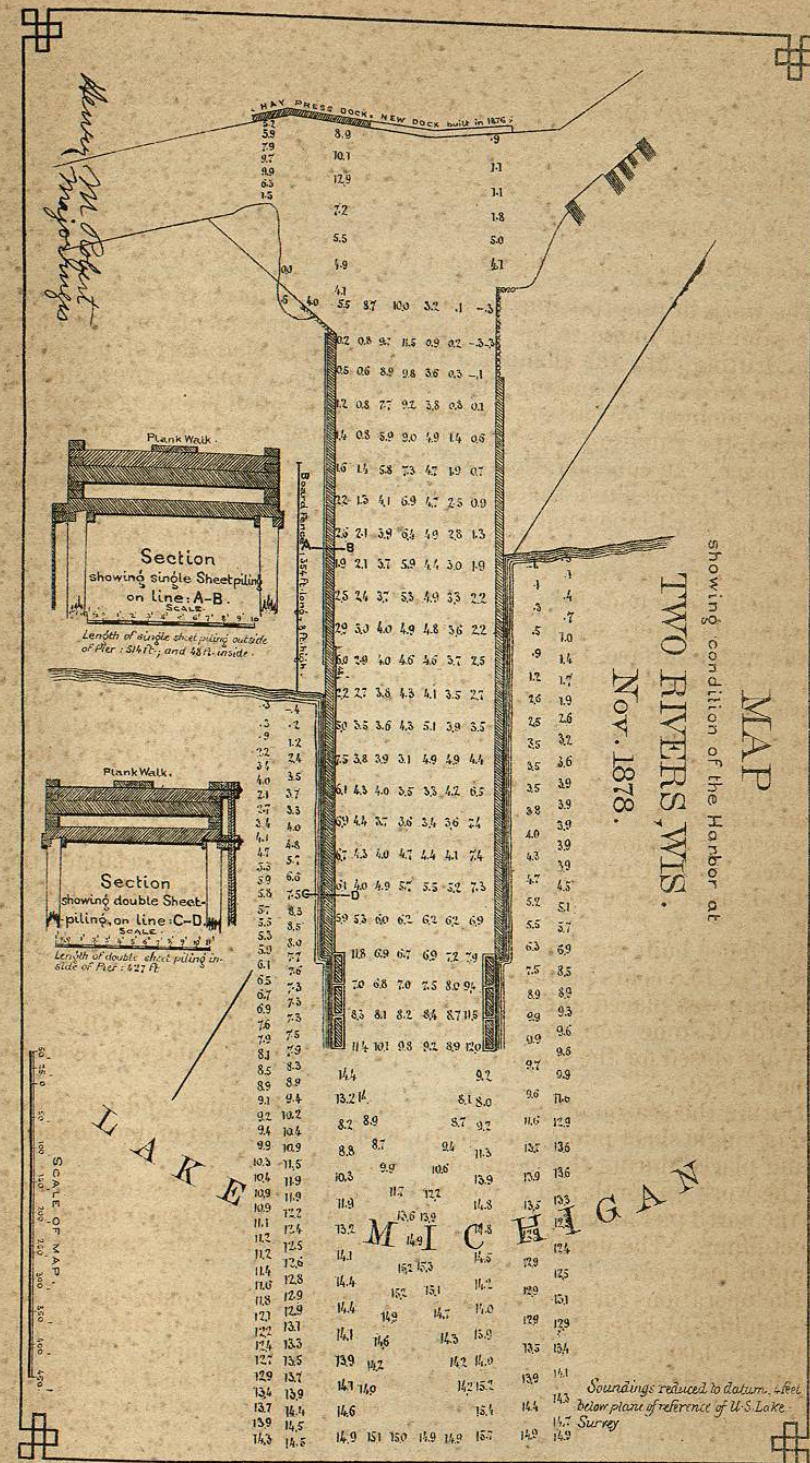
Work closed for the season of 1878 on November 25, and was resumed June 4, 1879.

During the season of 1878, 427½ linear feet of double and 562 linear feet of single sheet-piling was placed, with 313 linear feet of double sheet-piling placed during the month of June, 1879.

The work on south pier is completed, and there remains to be placed on the north pier about 215 linear feet of double and 280 linear feet single sheet-piling. The details of placing the sheet-piles is the same as that adopted last year.

The operations for present season will comprise the completion of the sheet-piling by hired labor, and the removal by the United States dredge of about 24,000 cubic yards of sand from between the piers. This work is required to permit the use of the inner harbor, and also to allow the cribs for pier-extension to be floated out. The piers will be extended by sinking about 10 additional cribs by contract.

The work proposed during the fiscal year 1880-'81 is the further extension of the piers, and dredging between them.



Money statement.

July 1, 1878, amount available.....	\$10,017 88
Amount appropriated by act approved March 3, 1879 .....	20,000 00
	\$30,017 88
July 1, 1879, amount expended during fiscal year.....	7,990 08
	22,027 80
Amount (estimated) required for completion of existing project.....	125,588 80
Amount that can be profitably expended in fiscal year ending June 30, 1881.	60,000 00

List of materials and labor used at Two Rivers Harbor, Wisconsin, during season of 1878.

Articles.	Price.	427½ linear feet double sheathing, south pile-pier.		48 linear feet single sheathing, south pile-pier.		514 linear feet single sheathing, without wales, south pile-pier.		354 linear feet of fence 8 feet high.	
		Quantity.	Am't.	Quantity.	Am't.	Quantity.	Am't.	Quantity.	Am't.
Oak plank, 2½ inches, feet b. m. ....	\$13 00					6,431	\$83 60		
Oak plank, 3 by 12 inches...feet b. m. ....	18 00	46,170	\$831 06	2,952	\$46 66	6,344	114 19		
Oak timber, 6 by 12 inches...feet b. m. ....	18 00	5,130	92 34	536	9 65				
Pine timber, 8 by 12 inches...feet b. m. ....	12 50	4,076	50 95	384	4 80				
Pine plank, 2 by 6 inches...feet b. m. ....	10 00	428	5 35	48	60	4,486	47 84	3,422	\$34 22
	12 50								
Screw-bolts, 1½-inch, pounds .....	02 85	3,282	93 54	384	10 49				
Iron and bolts...lbs. ....	03 45	540	18 65						
Wrought spikes...lbs. ....	03 4	1,281	43 55	72	2 45	368	12 12		
Coal-tar...barrels... ..	6 80		3 40						
Dredging and removing obstructions .....			118 94		13 46		26 00		
Handling lumber .....			165 22		9 17		44 40		
Framing .....			147 95		16 61				
Driving piles .....			287 70		16 44		148 66		
Repairs of machinery .....			211 40		11 69		90 51		
Fuel, supplies, &c. ....			148 45		8 37		38 84		
Freight and towage .....			24 85		1 40		8 75		
Proportional cost of plant platforms, engine-house, pile-driver, tools, &c. ....			194 47		10 94		75 41		
Cedar posts...No. ....	08						44	3 52	
Nails...pounds... ..	02 65						100	2 65	
Labor...days... ..	1 50						10½	15 75	
Total .....			2,437 82		162 73		690 32		56 14

RECAPITULATION.

Materials.....per linear foot.....	2 66	1 55½	0 50
Labor, supplies, &c.....do.....	3 04	1 83½	84
Total cost.....do.....	5 70	3 39	1 34
			0 15 8

REPORT OF MR. CHARLES CROSMAN, INSPECTOR.

MILWAUKEE, Wis., December 5, 1878.

SIR: I have the honor to submit the following report on the work of sheathing the pile-piers at Two Rivers Harbor:

The plan adopted was by driving a double row of sheet-piles of 3 inches by 12 inches by 18 inches oak plank 13 feet below the water surface, extending 5 feet above the water surface, their upper ends being upon a plane with the upper face of the superstructure, to which it was secured with 6 inches by 12 inches oak wale timber and 1½ inch screw bolts at the water surface, and to the upper course of timber of the superstructure. The water alongside of the pier varied from 2 to 8 feet in depth, averaging about 5 feet. It being believed impracticable to drive the sheet-piles the dis-

tance required, and have them retain a vertical position, and fit closely against each other, a "Heald and Sisco" centrifugal pump (6-inch) was used for the purpose of excavating a trench alongside of the pier, to give a depth of 10 or 11 feet of water, in order that the piles need not be driven more than 2 or 3 feet, thus reducing their liability of getting out of position.

METHOD EMPLOYED FOR DRIVING.

A 5-inch Ingersoll drill, that had been in use at various harbors for drilling rock, was fitted to a suitable frame, and, with a hammer weighing about 200 pounds, served as a driver.

The centrifugal pump worked well, removing about 135 cubic yards per day; but the exposed locality of the work rendered it nearly valueless, as a light wind would cause a sea sufficient to rapidly refill the trench that had been excavated by it.

The jet process, that had been so successfully used at other places, was then adopted. A "No. 3 Holly pump" was obtained; this pump did not possess the capacity claimed for it by the manufacturers, either from faulty construction or other causes, but answered the purpose very well when the material to be excavated was clear sand, free from all obstructions, such as logs, brush, stone, &c.; in fact, an occasional boulder did not cause much trouble, as it could be buried without much difficulty. A single stream, 1 1/2-inch diameter of nozzle, was usually employed, although a double stream was tried, also nozzles of less diameter; the difference in the results were imperceptible. An excavation through the sand was easily and rapidly made of ample dimensions to receive the plank. It was necessary to keep the pump in operation until the hose was removed, otherwise it would become imbedded in the sand and difficult of removal. After setting a plank in the first row, or next to the pier, the platform was moved back 6 inches by steam-power, in order to set the next plank in the second row, breaking joints with the first. There was no perceptible difference in the time required for making the excavation for setting the second plank and the first, as the holes would be four-fifths or more filled by the time occupied in shifting.

During the progress of the work quite formidable obstructions were encountered, portions of a wrecked vessel, sunken logs and stumps, and near the shore-line a very hard stratum of gravel and clay about 9 to 10 feet below the water-surface. The jet was unable to penetrate it, and the driver lacked the requisite power to drive the piles their full length. The double sheathing commenced at the outer end of the south pile-pier, upon its channel or inner side, and continued to the shore-line, a distance of 427 1/2 linear feet; adjoining this was also driven 48 linear feet of single sheathing (that being deemed a sufficient protection inside of the shore-line), making the total length of the sheathing on the channel-side of the pier 475 1/2 linear feet.

The cost of bolts, wales, and framing was the same on the single as the double sheathing, making the cost of the former about 60 per cent. of the latter, and it was thought best to protect the remainder of the pier by sheathing its outer face on the land side of the pier, allowing the upper end of the sheathing to lap about 1 foot on the superstructure, thereby economizing materials and labor. By this plan also work could be carried forward regardless of the rough condition of the lake.

The shore-line had advanced since 1870 the entire distance yet to be sheathed, viz, 514 linear feet; and there was found to be deposited against the pier a mass of small rubbish, consisting of sticks, chips, bark, and refuse stuff from sawmills, several feet in width and depth, with occasional obstructions of a larger character, such as logs, stumps, &c., that rendered the jet powerless, and the driver did not have sufficient power to drive the piles the depth required. A small pile-driver (24-feet leaders) of the ordinary style was then built and found to work satisfactorily; 8 to 9 feet plank, 2 1/2 and 3 inches in thickness were used and driven an average depth of about 7 and 7 1/2 feet, their upper ends being spiked to the wale timber that forms the base of the superstructure.

Sheet-piling south harbor pier at Two Rivers, Wisconsin, in 1878.

Description.	Number of linear feet.	Cost of materials, per linear foot.	Cost of labor, supplies, &c., per linear foot.	Total cost per linear foot.
Double, with wales .....	427 1/2	\$2 66	\$3 04	\$5 07
Single, with wales .....	48	1 55 1/2	1 83 1/2	3 39
Single, without wales .....	514	50	84	1 34

Work closed for the season November 25.

The materials required for sheathing the north pier are nearly all on hand, and a considerable amount of labor has been expended upon them. But few additional tools or implements will be needed to complete the sheathing of the north pier.

Very respectfully, your obedient servant,

CHAS. CROSMAN,  
Inspector.

Maj. HENRY M. ROBERT,  
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS, 1878.

Name of harbor, Two Rivers, Wisconsin; collection-district, Milwaukee, Wis.; nearest light-house, Twin River Point, Wisconsin.

Arrivals and departures of vessels during the year ending December 31, 1878.

	Arrivals.			Departures.		
	No.	Tonnage.	Crews.	No.	Tonnage.	Crews.
Steamers .....	250	125,000	8,000	250	125,000	8,000
Sailing-vessels .....	125	12,500	625	125	12,500	625
Total .....	375	137,500	8,625	375	137,500	8,625

Exports for the year ending December 31, 1878.

Chairs .....	dozen..	12,000	Laths .....	number..	2,000,000
Doors, blinds, and sash .....	number	25,000	Leather .....	pounds..	1,000,000
Empty barrels .....	do....	2,000	Lumber .....	feet b. m..	4,000,000
Fish .....	packages..	1,500	Pickets .....	number..	20,000
Flour .....	barrels..	5,000	Railroad ties .....	do....	50,000
Fresh fish .....	pounds..	550,000	Slabs .....	cords..	6,000
Furniture .....	pieces..	20,000	Wood .....	cords..	3,000
Grain .....	bushels..	5,000	Woodenware .....	dozen..	80,000
Hair .....	pounds..	90,000	Sundries .....	pounds..	35,000
Hay .....	tons..	100	General merchandise .....	tons..	3,000

Imports for the year ending December 31, 1878.

Bark .....	cords..	6,000	Hides, green .....	bundles..	11,000
Flour .....	barrels..	1,500	Salt .....	barrels..	1,000
Grain .....	bushels..	12,000	Shingles .....	number..	1,000,000
Hard-wood lumber .....	feet b. m..	800,000	White wood .....	cords..	500
Pine lumber .....	do....	5,000,000	General merchandise .....	tons..	8,000
Hides, dry .....	number..	15,000			

This information was obtained from the Two Rivers Manufacturing Company and the Badger State Manufacturing Company.

Z 9.

IMPROVEMENT OF MANITOWOC HARBOR, WISCONSIN.

Original and subsequent estimates to get 18 feet of water .....	\$248,182 54
Appropriated since .....	232,820 00
Leaving to be appropriated.....	15,362 54
Amount which can be profitably expended in fiscal year 1881-'81 .....	12,000 00

The operations for the past year have consisted in sinking 6 cribs; 3 in continuation of each pier. With this work the piers have a present extension of about 1,620 feet on the north side and 1,550 feet on the south side, the present extension reaching within about 50 feet of the 18-foot curve.

The operations for the present season will comprise the construction of superstructure over the 6 cribs placed last year, together with such refilling, replanking, and repairs to existing work as may be necessary.

During the fiscal year 1880-'81, it is proposed to complete the pier extension to the depth of 18 feet, as contemplated in the projects and estimates previously made, and to make such repairs and do such dredging as may be necessary.

The amount required to complete this harbor, if appropriated in one sum, will be within the estimates therefor, even though a considerable amount of the appropriations have, at times, been expended on repairs.

The position of this harbor is such as to make its completion a matter of interest to the whole lake commerce, and previous recommendations touching its early completion are respectfully renewed. (See Report of the Chief of Engineers, 1877, p. 863, and 1878, p. 1160.)

Money statement.

July 1, 1878, amount available.....	\$15,069 29
Amount appropriated by act approved March 3, 1879 .....	6,500 00
July 1, 1879, amount expended during fiscal year .....	\$21,569 29
July 1, 1879, amount available .....	12,805 64
July 1, 1879, amount available .....	8,763 65
Amount (estimated) required for completion of existing project .....	15,362 54
Amount that can be profitably expended in fiscal year ending June 30, 1881.	12,000 00

List of materials and labor used at Manitowoc Harbor, Wisconsin, during the fiscal year 1878-'79.

Articles.	Quantity.	Price.	Six cribs, each 50' x 24' x 13 1/2'.
Pine timber, framed, 12" by 18".....linear feet..	600	\$0 30	\$180 00
Pine timber, framed, 12" by 12".....do.....	23,593.3	20 1/2	4,836 63
Oak timber, framed, 12" by 12".....feet, b. m.	8,208	20 00	164 16
White-oak piles.....linear feet..	2,101.5	10	210 15
Piles driven.....number..	72	2 50	180 00
Stone filling.....cords..	977.22	4 90	4,788 38
Drift-bolts.....pounds..	30,241.9	02 1/2	831 65
Screw-bolts and washers.....do.....	563.96	04	22 56
Chain and fittings.....do.....	8,042	04	321 68
Spikes, wrought.....do.....	28	01	28
Total.....			11,535 49

Abstract of proposals opened July 30, 1878, by Maj. Henry M. Robert, Corps of Engineers, U. S. A., for improving harbor at Manitowoc, Wisconsin

Materials.	Quantities.	Chicago Dredging and Dock Company, Chicago, Ill.	Knapp & Gillem, Racine, Wis.	Archibald McArthur, Chicago, Ill.	Gibson & Rankin, Manitowoc, Wis.	Jasper Hanson, Manitowoc, Wis.	O. Torrison, Manitowoc, Wis.	Truman & Schroeder, Manitowoc, Wis.
		Rate.	Rate.	Rate.	Rate.	Rate.	Rate.	Rate.
Pine timber, 12 inches by 18 inches.....linear feet.	400	\$0 55	\$0 35	\$0 45	\$0 32	\$0 30	\$0 30	\$0 30
Pine timber, 12 inches by 12 inches.....linear feet.	15,000	26	27	24	23 1/2	22	23	20 1/2
White-oak timber, 12 inches by 12 inches.....feet, b. m.	5,700	35 00	25 00	25 00	12 00	18 00	20 00	20 00
White-oak piles.....linear feet.	1,600	13	15	15	10	12	15	10
Pine plank, laid, 3 inches by 12 inches.....feet, b. m.	1,000	15 00	12 00	20 00	10 00	12 00	10 00	50
Iron drift-bolts, 1 1/2 inches square.....pounds.	18,000	03	03	03	03	02 1/2	02 1/2	02 1/2
Iron screw-bolts, 1 1/2 inches round.....pounds.	300	04 1/2	04	05	04	07	04 1/2	04
Chain and fittings.....do.....	8,000	05	07	05	05	06	04 1/2	04
Spikes, 9 inches, wrought, pounds.....	100	03	03 1/2	05	04	05	03	01
Stone.....cords.	500	7 00	6 50	6 00	5 00	5 00	4 75	4 90
Brush.....do.....	40	7 00	3 00	3 00	2 00	1 70	1 50	50
Driving piles.....number.	50	3 00	3 50	3 00	3 00	4 00	3 00	2 50
Total approximate value.....		9,429 00	9,245 00	8,412 50	7,577 40	7,450 60	7,390 50	6,892 50

COMMERCIAL STATISTICS, 1878.

Name of harbor, Manitowoc, Wis., collection district, Milwaukee, Wis.; nearest light-house, Manitowoc, Wis.

Arrivals and departures of vessels for the year ending December 31, 1878.

	Arrivals.			Departures.		
	No.	Tonnage.	Crews.	No.	Tonnage.	Crews.
Steamers.....	434	286,626	12,300	434	286,644	12,324
Sailing-vessels.....	428	36,595	1,601	438	37,353	1,632
Total.....	862	323,221	13,901	872	323,997	13,956

Exports for the year ending December 31, 1878.

Brick.....number..	428,500	Flour.....barrels..	31,346
Ice.....tons..	4,660	Wood.....cords..	14,891
Cattle.....head..	640	Hay.....tons..	2,104
Pease.....barrels..	7,557	General merchandise.....tons..	*7,290
Feed.....tons..	1,015	Railroad ties.....number..	20,550
Shingles.....number..	897,000	Posts.....number..	9,600

Imports for year ending December 31, 1878.

Bark.....cords..	402	Lumber.....feet b. m..	2,802,000
Shingles.....number..	7,031,000	Pickets.....number..	40,000
Coal.....tons..	152	Plaster rock.....cords..	130
Slabs.....cords..	2,763	Salt.....barrels..	2,725
Laths.....number..	175,000	General merchandise.....tons..	*9,200

The above information was obtained from Mr. John Nagle, editor of Manitowoc Pilot, Mr. G. B. Burnet, deputy collector of customs, and others.

\* Partly estimated.