

Pernambuco memo

In Connection with the dredging of the harbor, and depositing the material so as to avoid its return, and, if practicable, to utilize the material dredged and at the same time to increase the force of the scour, the following plan has suggested itself to me.

It is known that a very large ^{wide passage of the} area of the Passarellas is quite shallow and indeed much of it is exposed above water during low tide.

It is proposed to transform a portion of this area into an island to be raised up by depositing the dredged material upon it.

There is never any heavy action of the sea on this bar, and the waves produced by the winds are not very high. It is therefore easy to build lines of cribs or to crib lines of piling to bound the proposed island.

Pernambuco Mem

More than half of all the sugar and Cotton received in Pernambuco for ocean shipment is brought in the barancas or small coasting vessels; and this can be discharged from the barancas directly into the ocean vessels (excepting such portions as may have to be previously stored in city warehouses).

Of course whatever amount is thus transferred directly from the barancas

Recommendations.

- I. Systematic Dredging - and work connected therewith.
- II. Raising the submerged reef between the Barra Picão and the Barra Grande, ^{and establishing} ^{and buoys.} beacon light, ^{on piles.}
- III. Extending the unfinished Quay wall northward,
- IV. Protecting and regulating the Barra Picão, and raising the reef toward the Light-House.
- V. Building iron quay piers.
- VI. Repairing the walls on the reef opposite the Commercial Part of the Port.

Pernambuco

Concerning Proposed Breakwaters Outside.

Plans for extensive breakwaters to form an outside harbor have been presented by several engineers.

M. Furnie proposed three; and Sir John Hawkshaw one, extending out from the reef in a partly Curving direction; and he referred to a second, on the English Bank, as having been proposed by M. Furnie; but ~~did~~ ^{not} include it in his estimate; intimating that the one he recommended ^{would be} sufficient for the present. He estimated the cost at £950,000.

The report says "In order effectually to protect the wharves, and to enable large steamers which cannot enter the port, to discharge passengers and cargo, it is desirable to construct a pier or breakwater, AB, running out from the reef as shown in the drawing. By building it with vertical sides, the steamers could go alongside, on one side or the other according to the wind prevailing at the time, as is the case at the Admiralty Pier at Dover. It would also give shelter in most winds, for boats and barges to pass backwards and forwards through the Barra do Picão."

Elsewhere the report says "If the government should conclude that the pier AB, running out from the reef is too costly, then I should recommend raising the reef between the two barras, so as to protect the Poco."

It will be observed that the recommendation of the breakwaters outside does not include the construction of a bridge across the harbor

to Connect the breakwater with the Commercial front of the City. Any bridge would of course have to be a drawbridge, and a drawbridge across the harbor of Pernambuco, would be an actual nuisance; the very reverse of an improvement of the port. Yet without such Connecting bridge, the breakwater would be of little value as a landing place for Passengers or Cargo.

The report indicates "building it with vertical sides, for steamers to go alongside, on one side or the other according to the wind prevailing at the time."

Upon whatever plan it might be built, there would be serious practical difficulties in the way of using it for landing ^{Passengers,} or loading ^{or unloading} ~~Passengers~~ or Cargo, without a bridge across the harbor. They would have to be conveyed along the pier to the reef, and then transferred to boats, to go either to the Custom House, or to other quays, and there ^{be} disembarked. Going on board, the process would be nearly reversed. And respecting ^{the use of} ~~using~~ the breakwater as a landing place for goods and passengers: that could only be accomplished by having an elevated frame of iron, or wood, built upon the breakwater; otherwise the swell, and ^{the} sea-spray would keep the place nearly always wet, and unfit for such purposes.

Steamers, with steam up, could select the side of the breakwater according to the wind prevailing at the time; but other vessels could not move, in case of a change of wind, from

the windward to the leeward side.

A breakwater, exposed to the sweep of the Atlantic, outside of the reef, can be built metres in length, for the sum estimated; which, in round numbers, is ten millions of Milreis (10,000,000\$) or probably, by contract, for considerably less; perhaps for not exceeding nine millions. When finished, it would make a harbor of refuge, and greatly improve the outer anchorage, and materially facilitate loading and unloading by means of lighters, which now, owing to the swell of the sea, are often prevented from working outside.

It is however to be considered that a very much smaller sum will so materially improve the port that there will be scarcely any occasion for lighters, ~~even~~^{ever} to go outside.

It is notorious that it is very inconvenient for passengers to land from, or to go on board of the vessels outside; but the true remedy is to bring the vessels inside by deepening the port, and protecting the Poco anchorage.

The annual interest on ten millions of Milreis, is seven hundred thousand Milreis; or nearly two thousand milreis per day. For a few hundred milreis per day, a Commodious transport steamer could be maintained to ply between the City and the large, deep draught steamers outside.

But with the alternative plan recommended by Sir John Hawkshaw, and other engineers who have studied the subject, namely, raising the submerged reef between

the two barras, so as to make it a breakwater, at an estimated cost of only £60,000, as given in his report, the indicated outer breakwaters could properly be deferred to some future time.

The construction of a costly structure like the one proposed, which when completed would create a harbor of refuge, is one thing; but the improvement of the port of Pernambuco, for business purposes, is another thing; and which is practicable at very much less cost.

In the event of raising the submerged reef, and should it be decided to leave a passage open for boats and light draught vessels at the Barra Picão, a small breakwater could be extended obliquely out from the Tartaruga rock. This would not only protect the entrance from the heavy swells, but it would serve to greatly reduce the ~~force~~^{waves} passing into that part of the port, and render it much safer and easier to dredge the shoals inside.

harbor has a general width of about 180^{to 200} metres, averaging about 190 metres; and this portion cannot conveniently be made wider.

The foregoing figures, without some explanation, will convey an erroneous idea of the available area, at present, for the shipping, ^{especially} during low tide; as considerable portions, on the City side, are not deep enough; but by dredging, this entire area, comprising 125 acres - in round numbers 510,000 square metres, can be used by the shipping.

For vessels drawing not over 4½ metres (14¾ feet) there are about 100 acres available; for vessels drawing 5 to 5½ metres (feet) there are about 70 acres, not all conveniently available; for vessels drawing 6 metres, ^{there are} ~~not~~ not over 30 acres, chiefly between the Arsenal and Custom House point, over toward the reef. There for a length of 500 metres there is now a narrow channel with a low tide depth of 7 to 9 metres.

By securing the foundations of the Quay, the whole ^{area} ~~area~~ of 125 acres will admit of being dredged to a depth of 7½ metres, with a greater depth (as there is now,) sufficient for ^{special} vessels of ^{greater} ~~greater~~ draught. Two turning places for the longest vessels can be arranged - one at each end of the harbor; namely, nearly opposite the light house, and opposite ^{in front} ~~the~~ ~~area~~ of the Custom house; so that the longest need not back out.

Besides, when the harbor shall be dredged to the depth of 7½ metres upon its full width, the narrowest place will be 180 metres, or 590 feet, so that if it were unencumbered with vessels

the longest ship in the world excepting the "Great Eastern" could turn in any part of it.

At present being deep only on one side a very long vessel of much draught cannot turn

Approximate Calculations from the present soundings show, that to obtain 6 metres depth over the entire area of 125 acres, it would require the dragging of Cubic metres,
 # including 200 metres width through the ¹Requiere Shoal; and to obtain the depth of $7\frac{1}{2}$ metres in a length of 1600 metres and 50 metres
 # wide, Cubic metres more.

Including a turning place at each end, 250 metres each, there would then be a length of 2100 metres, extending through the port, beginning at a point 250 metres north of the light house.

Between that point and the Channel entrance at Barra Grande, very little if any dragging would be necessary, as there is already a depth of 7, $7\frac{1}{2}$ and 8 metres inside of the submerged reef.

Pernambuco

Spays

Inclusion

Pernambuco Conclusion.

The city of Pernambuco already possesses an excellent harbor and good roadsteads; the latter being unusually free from dangerous gales, with safe anchorages, ^{nine and} in ten metres or more depth, from three fourths to one and one fourth mile ^{out from} of the port. The anchorages are not subject to material changes, and vessels rarely encounter serious trouble when at anchor.

This port, excellent as it is, for a certain class ^{of moderate draught,} of vessels, admits of material improvement. It can be made much deeper, more convenient, and more capacious, by the expenditure of a sum, which, compared with the resulting benefits cannot be regarded as unreamable. The works that appear most desirable may be ^{referred to} ~~described~~ as follows:

needed under the following heads:

This is brought in at the Recommendations. page.

420,000	I.	Systematic dredging - and work ^{connected therewith.}	Estimated cost.
550,000	II.	Raising the submerged reef between the Barra Picão and the Barra Grande - and establishing beacon lights & buoys.	Estimated cost
95,000	III.	Extending the unfinished quay wall northward - on piles.	Estimated cost
230,000	IV.	Protecting and regulating the Picão entrance - and raising the reef thence to the light-house.	Estimated cost
120,000	V.	Building short, open iron quay-piers.	Estimated cost.
60,000	VI.	Repairing, ^{and building new} wall on the reef opposite the Commercial ^{part of the port.}	Estimated cost.

1,475,000

295,000

1,770,000

2 per cent. for superintendant's expenses & contingencies.

In order to a clear understanding of the good to

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be accomplished by these proposed improvements it may be proper to consider them somewhat in detail, under their respective heads, as follows:

1. Systematic dredging, etc.

Supposing a Contract to be made with experienced, competent parties to perform the required dredging, by the Cubic metro of effective dredging, it might be advantageously carried on as follows:

First, assuming 6 metres below low water spring tides as the depth for the dredging.

Second, proceed to cut a Channel 50 metres wide from the Light-house Southward to a point opposite the Public Landing, just below the Marine Arsenal, (about 900 metres,) below which there is already a channel 6 metres or more in depth.

The soundings of 1880 show that the greatest depth of material to be removed, through ^{this} part of the Brequede Shoal, will be only 1.50 metres. In round numbers there will be 300 metres of 1.50 depth, 300 metres of 1.00 depth, and 300 metres of 0.50 depth of excavation, or in all, 45,000 Cubic metres.

One half of this will be difficult to manage on account of the roughness of the water in the Brequede Shoal; the residue will be easy. But even allowing that the cost might be 2,000 per Cubic metre for the whole ^{of this more difficult part,} the sum would be but 90,000.

What will have been thereby secured? A clear Channel, with a least depth of 6 metres at low tide, and of 8 metres at high tide, between the Ocean and the extreme Southern extremity of the port, in front of the Custom House!

For this comparatively small sum, the Capacity of the port of Pernambuco, would be at once

(3)

increased
^ One and a half metres of depth for entering and departing vessels. At present, vessels drawing more than $4\frac{1}{2}$ metres (14.76 feet) cannot enter at low tide, and 6 metres draught (19.68 feet) is considered the maximum admissible at high tide.

With the increased channel depth of $1\frac{1}{2}$ metres, ^{secured,} as above, ~~secured,~~ vessels drawing 6 metres (19.68 feet) could enter, ^{and depart} at ordinary low tide, and vessels drawing 7 metres ^(23 feet) (or even more) ~~could~~ could enter and depart at ordinary high tide.

With a first class dredge, and the requisite accommodations, in the hands of experienced men, this could be effected in three or four months. As before explained, there is no difficulty in berthing vessels, after they are inside of the Bregueda Shoal, in a depth of 7 metres or more, in the Mosqueiro, opposite the Custom House.

According to my judgment, if nothing else were to be done, the effect of ^{thus} increasing the entrance depth one and a half metres, would be worth ten times the ^{estimated} cost of obtaining it.

Third. The next process would be, to double the width of this excavated channel, making it 100 metres wide; at least in that part below the Bregueda Shoal. The widening of the channel through the shoal could be deferred till the works at the Picão entrance should protect that part of the port from injurious ocean swells.

Fourth. Dredging could then go ^{on} in all parts of the port south of the Bregueda Shoal, ^{wherever} ~~where~~ it is now less than 6 metres deep at low tide; leaving a margin in front of the Quay walls without dredging.

* The dredged material from the lower part of the port, and from the proposed "Gare", or wide turning place, should be deposited from scows, so as to form land. A portion could be placed at some convenient point in the Lagoon whos, and kept from being washed away by means of piles and plankings. So that time need be sent outside of the reef.

By dredging 400,000 Cubic Metres in addition to the foregoing 45,000 Cubic metres, a depth of 6 metres on a width of 150 metres, along the entire length from the Light House to the Recife Bridge, can be had. In addition, a turning place, or "Gare", in front of the Custom House, and another north of the Light house should be arranged.

An additional excavation of 90,000 Cubic metres would complete a turning place opposite the Custom House, 250 metres in diameter, 6 metres deep below low tide.

No work need be done in the Poco north of the Picão entrance in widening the Channel till the submerged reef shall have been raised; when it will probably be found that little if any dredging will be necessary to make a sufficient turning place near the lower end of the Poco. The total quantity of dredging advised is therefore 535,000 Cubic metres.*

II. Raising the submerged Reef between the Barra Picão and the Barra Grande - etc.

It is proposed to raise this reef with stone, to be brought down the "Limeira Railway" in Company with Mr. Elliott, Chief Engineer of the Company with this railway as far as San Lourenço Station, 26 Kilometres out from the City, making particular observations for stone. There is an abundance of excellent granite, well adapted to break-water purposes between 15 and 25 Kilometres from Recife. The stones can be conveniently quarried, loaded upon Cars, transported by locomotive to a temporary wharf to be prepared near the Company's Terminal Station, where they can be readily transferred to scows and taken by a tug to the reef, and

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then dropped upon the reef, beginning on the outward
or sea side of the reef. It is not proposed to
transform this submerged reef into a quay; but
merely to raise it with rough, large ~~rough~~ stones
to such height as will cause it to break the
level of the sea, and render the anchorage
inside comparatively calm, ^{and safe at all times.} Guide posts can
be set up on the reef and filled around with stone
so that the scows may be discharged in the
proper places.

The length to be raised is 500 metres, and the
average depth of the reef below high water spring
tide, is taken at $4\frac{1}{2}$ metres - the slope, on the
sea side may be made 4 base to 1 rise, and on
the inside 2 base to 1 rise, with a thickness on
top of 3 metres. This requires 30,000 cubic metres.

It may be found that a somewhat less quantity
of stone might be sufficient. This can be quarried,
transported to the coast, delivered on scows, and
dropped in place for from 15 to 18 milreis per cubic
metre - depending partly upon the size of the stones.

Putting it all at 18,000 per cubic metre, it would be 540,000,000
and adding 20 per cent. ^{for superintendence,}
engineering and contingencies, ^{including beacons, lights, etc.} 90,000,000
gives a total of ----- 630,000,000

If this were divided into two years, it would require
the delivery of 15,000 cubic metres per year; and allow-
ing 300 working days, it would be 50 cubic metres per
day. At $2\frac{1}{2}$ cubic metres per car, it would require 20
car loads per day. As the distance need not exceed
25 Kilometres ($15\frac{1}{2}$ miles) this ^{quantity} ~~amount~~ would be easily manageable.

III. Extending the unfinished quay northward. On piles.

150
500
75000

I would advise the extension of the present ^{nearly} quay in the same line, 500 metres northward, to a point opposite the Picão entrance; to serve two purposes: one, to limit and regulate the width of that part of the additional port room to be made by the raising of the submerged reef, and other works; and the other, to make a place behind the wall for the deposit of the dredged material from the northern part of the port. Having this convenient depositing place where much of the dredged material can be dumped or shovelled from scows, the cost of dredging would be materially reduced.

This line of wall should run so as to be about parallel with the submerged reef, at the distance of about 300 metres, in case it should be farther extended hereafter.

By placing 3 piles across, at intervals of 1 metre, there would be 1500 piles in the length of 500 metres. The piles should not extend above the level of low water mark, and assuming that their average length should be 6 metres, averaging about 0.30 diameter, of round timber, the cost should not exceed 20¢ per foot each, or for the piling 30,000 \$000. These piles should be covered with ^{3 lines of} scantling, one upon each range of piles, upon which strong planking should be spiked, (cross-wise) upon which the wall, of rough rubble masonry, ^{was} to be built - 2^m thick at bottom, 1¹/₂^m at top 3 metres high = 5.25 cu. metres = 2625 Cuh. metres for 500 metres length.

Rough Estimate		
1500 piles @ 20¢		30000 \$000
14850 B.M. scantling @ 100¢		14850 \$000
17325 " " Plank @ 100¢		17325 \$000
2625 C. m masonry @ 15¢		39375 \$000
20 percent	87.772	72592 \$500
		72592 \$500

III. Extending the unfinished Quay Northward - on piles.

The present unfinished quay, continued nearly in the same line, should be extended about 500 metres northward to a point opposite the Picão entrance. This line of wall should run so as to be parallel with the direction of the submerged reef about 300 metres inside of it, admitting of future extension in the same line. This wall is intended to serve two purposes. One, to limit and regulate the width of that part of the new port; the other to make a convenient place, behind the wall, for the deposit of the dredged material taken from the northern part of the port. Having this handy place of deposit, when much of the dredged material can be either dumped or shovelled from the scows, it should reduce the cost of dredging and disposing of the material. At the same time this material will assist in forming valuable land, available for commercial purposes.

Another effect of this wall will be to direct the general current through the southern part of the POCO parallel with the reef, rendering it less liable to create a bar.

IV. Protecting and regulating the Picão entrance and raising the reef thence to the Light House.

This entrance should either be entirely closed, or it should be arranged so that the swell

If at a future time it should be deemed worth the cost to found a new quay to the full depth of the port, the proposed piers need not interfere with that work; and even after such work should be completed, the piers would be found advantageous. It is not probable that, even then, lightning could be entirely dispensed with.

The precise location of these piers is a matter of detail to be hereafter arranged. The present estimate covers the cost of two piers, six of which are assumed to be in front of the Custom House.

VI. Repairing, and building new Wall on the reef opposite the Commercial part of the port.

While this may be less pressing than the other works indicated, it is desirable that there should be a substantial wall along the reef, sufficient to prevent heavy seas from breaking over so as to disturb the shipping moored near the reef. A plain, stone ^{which} wall about two metres thick and one ^{and a half} metres high, will answer the purpose.

80,000#

from the ocean through it will be reduced, and so that it will act less injuriously in creating and maintaining an inside bar. With the submerged reef raised so as to form a breakwater, and the reef laid southward from the Tartaruga rock toward the light-house, and a spur protection on the south side of the entrance to break the ocean swell, the Barra Picão may be rendered both safer and more convenient. It is however to be considered, that when the port shall have been deepened so as to admit nearly all vessels that may desire to enter, there will be much less use for this minor entrance; though it will still be convenient for light craft coming from or going to points south of Pernambuco. For points on the coast north of Pernambuco, the Barra Grande entrance is an sufficient.

V. Building short, open iron quay-piers.

It has heretofore been proposed to build a new wall, outside of the present quay, to be founded seven metres below low tide; which would of course prove to be a very costly structure, on any plan. The object of this wall, ^{being} to enable dredging to be carried to the full depth close to the wall, and to maintain full depth across the entire width of the port.

In lieu of this, it is recommended that the 6 metre depth of dredging be stopped about fifteen metres out from the present quay, and that at convenient points open iron piers, ^{15 metres long, between the quay ^{and deep water}} be extended out to the 6 metre depth, so that vessels can ^{at all times} load and unload at the piers. The spaces between these piers can still be used, precisely as they are now used, by light draught vessels, when the tide is up.

This proposed arrangement of piers will be especially advantageous in front of the Custom House.

The customary anchorage, ^{called "Lameirões,"} for vessels of war and merchant ships unable to cross the bar, is in 5 fathoms of water 1 mile south east of the light-house. The best holding ground is in 6 fathoms, Picão Light-house bearing North West $\frac{3}{4}$ West, and the remarkable tree of Olinda North $\frac{1}{4}$ East; southward of this anchorage the bottom is rocky; and it would be well to examine the lead before letting go the anchor any where. Another good berth is about midway between the South buoy on English Bank and Picão ^{called "Laminhas" anchorage.} Light-house, the depth here is 26 feet, the light-house bearing West, the remarkable tree on Olinda North $\frac{1}{4}$ East. The disadvantage of this ^{for sailing vessels,} anchorage is in the difficulty of weighing with safety and casting so as to clear English Bank; the advantage is in the much shorter distance boats have to go to communicate with the shore. For steamers not drawing more than seven metres (23 feet) this is very convenient.

Pernambuco must always be important as the Port of call for merchant ships before proceeding to the port of discharge, or for loading.