

Madras Port Trust.

SCHEME

FOR

SHIP QUAYS

TO COST, WITH FULL EQUIPMENT,

Rs. 73,00,000 OR £486,000

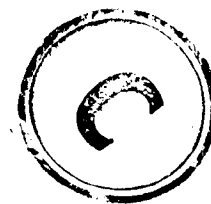
OFFERED TO THE PORT TRUST BOARD

BY

MR. FRANCIS J. E. SPRING, C.I.E., M.INST.C.E.,

Engineer-Chairman, Madras Port Trust.

AT THE MEETING OF SEPTEMBER 10th, 1909.



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Ship Quays for Madras Harbour.

*Memorandum by Mr. F. J. E. Spring, C.I.E., Mem. Inst. C.E., Engineer-Chairman,
Madras Port Trust, dated 1st September 1909.*

1. *Suggestion for a further development of the Port.*—Although it is very unlikely that I shall remain to superintend the construction of the further improvements in Madras Harbour foreshadowed in this note, it may be of interest to the Port Trust, to the Chamber of Commerce, to the Trades Association, to the Railways, to the Steamship Companies and to the Government of Madras, if I offer an opinion as to the general lines of future structural development in the harbour and the probable cost of such development. The 60-lakhs worth of work, consisting of the alteration of the entrance of the harbour and of the construction of the boat basin for the shelter of a launch and lighter fleet, is now approaching completion, and those concerned will be well advised to make up their minds whether or not to go still farther, now that it is certain that smooth water will be secured, and to develop the port on the most modern lines, so that ships may lie alongside quays where a great part or all of their cargo can be handled not only, as now, by ships' tackle over side into lighters, but also by big gantry cranes on quays.

2. *The limitations of this Memorandum.*—The object of this memorandum is to give the Port Trustees and Government some rough idea of what it will cost to make the Port of Madras in all respects an up-to-date port. The memorandum makes no pretence to present a cut and dried project which might safely be undertaken straight away if the money required for its completion were suddenly to become available. Indeed, if a half million sterling were unexpectedly to become available for the purpose of converting Madras into a thoroughly up-to-date port, it would be necessary most carefully to prepare detailed designs and proper working drawings instead of the rough sketches now presented. But for the rough and preliminary purpose now in view—viz., of ascertaining how much money is probably required and how, if borrowed, payment of interest on it and the extinguishment of the debt may be financed—the sketches and estimates now submitted are, I venture to think, sufficiently reliable and err rather on the side of liberality. Naturally, the first thing those responsible will think of is whether the trade of the place is likely to be able to sustain the burden of further expenditure on capital account on the scale indicated, without being handicapped thereby in its competition with the trade of other Indian ports. With regard to this consideration I can only indicate in a general and tentative manner, by means of a diagram, Plate I., and a forecast, Appendix V, what seem to me to be the prospects of the Port Trust's net earnings in the coming years, as the result of past experience. My forecast may be taken for what it is worth. It pretends to be no more than a forecast, based on past experience. Anyone can draw the curves for himself.

3. *Will further expenditure pay.*—In recent years the trade of the port has been increasing steadily; largely, no doubt, as the result of the facilities provided in the last five years for its handling and storage. But it is conceivable that this satisfactory increase may not continue, in the face of the further facilities offered to trade by Bombay and Calcutta, unless the Port Trust goes on to provide further and more modern equipment. Judging by analogy, and in view of the increase of trade that has undoubtedly occurred as shown on the trade curve of the diagram, I am inclined to the belief that reasonable expenditure on ship wharves ought to pay. And when I say reasonable expenditure I have in my mind some such figure as Rs. 60 to 80 lakhs to be repaid, principal and interest, in, say, 50 or 60 years from the date of the complete allotment to us of the loan. For we must hope it will be a Government loan, like our current loans, and that we shall not have to go for it on an unwilling and a restricted market.

4. *Suggestion for an Imperial grant.*—But it seems not unreasonable to hope that, just as they have done already in the case of 20 lakhs of our 60-lakh expenditure now coming to a close, the Imperial Government may be generous enough to allot us a like grant, say of Rs. 20 lakhs, in recognition of the Imperial, and not merely Provincial, importance of a harbour on the East Coast of India equipped up to modern standards. This is a matter for after negotiation, and need not be pressed in a technical note such as this must be, but I have shown the probable effect of it in Appendix VI.

5. *Present state of the Harbour.*—The present state of the harbour may be described briefly as follows, and in this description I will assume that the works now in hand and nearing completion have been completed duly.

- (a) Smooth enough water has been secured for ships to lie alongside wharves.
- (b) Even smoother water has been secured in the 10-acre boat basin for launches, dredgers, lighters and small craft.
- (c) As the result of (b) there is a large fleet of 40 to 100-ton lighters.
- (d) There is an area of 259,000 sq. ft. of shedding, or about 6 acres.
- (e) Piers are as follows—
 - (i) An ocean screw-pile pier, now 50 years old and very unsafe.
 - (ii) A pier 450 ft. $\times$ 40 ft., for dutiable imports, equipped with 16 hydraulic cranes.
 - (iii) A pier 300 ft. $\times$ 36 ft., for exports, with 8 hand cranes.
 - (iv) A pier 310 ft. $\times$ 42 ft., for non-dutiables, with 12 hydraulic cranes.
 - (v) Screw pile wharf, alongside which certain ships may lie.
 - (vi) Five little jetties with hydraulic cranes for bar iron, and six more with hand cranes for timber.
 - (vii) A length of some 600 ft. of the south harbour arm has been equipped with adequate sidings and has a 15-ton crane on it and can carry as many 3 and 5-ton steam cranes as are needed.
- (f) There are berths inside the harbour for nine vessels of the usual tonnage of these seas and two berths outside; but at a pinch two or three more can be accommodated in fair weather. Later, a ship will be able to lie up alongside the place, soon to be closed, where at present is to be found the old harbour entrance, and another alongside the new north arm.

6. *Considerations suggesting this Memorandum.*—Two considerations have urged me on to write the present memorandum. First: That, undoubtedly, there is going to be secured inside the harbour, as the result of the heavy expenditure now being incurred in altering its entrance, water smooth enough to allow vessels to lie alongside quays. Until recently this consideration could not be quite counted on; but the Port Trust engineers have watched very carefully the effect of the opening of the new entrance—now considerably wider than it will be when completed—and feel well assured that practically all movement within the harbour is due to the old entrance which will be quite closed up in the next 18 months, and that no swell of any account will come in through the new entrance. Now the whole aim and object of the heavy expenditure and burden of debt involved in the alteration of the harbour entrance has been that the harbour might be smooth enough for vessels to lie alongside quays. It is therefore only the logical sequence of such expenditure if I put forward a sketch of how this may be done, at what cost, and how the cost may be financed.

7. *Old ocean pier now moribund.*—The second consideration which has induced me to write the present memorandum is that the screw-pile ocean pier, half a century old, cannot remain effective much longer—indeed I am not disposed to give it another five years of safe life. The scheme put forward shows how it may be replaced. The cost of its replacement is heavy certainly, viz., 15 lakhs for the pier and Rs. 5 lakhs for its complete equipment with sheds, cranes, roads, tracks, winches, lifts, fenders, bollards, trucks, etc., fit for use with lightered cargo. I may mention however that for the money I get some 128,000 sq. ft. of pier as against 48,000 sq. ft. of old pier, at a cost of Rs. 12 per sq. ft. as against the Rs. 22 which the old pier cost. Needless to say, the new design gives a far more efficient machine for the handling of cargo.

8. *Suggested new pier will need deep wells.*—But it would be unpermissible, in replacement of the present screw pier, to build any sort of permanent jetty of which the walls should not be sunk deep enough to enable the entire bottom of the harbour to be dredged out, later, to 30 feet, and even 32 feet deep. And thus it came about that I designed what are practically ship quays for replacement of the old ocean pier, and having done so I found it easy to apply the same design to a north and south alignment of quays, from the north arm to the south arm of the harbour.

9. *The design for ship quays now put forward.*—I want it understood clearly that the sketches now put forward make no pretence to being a complete design. At this stage, figures and finance have chiefly to be considered and, in a general way, there must be some assurance that the sketch proposals are not likely to be inadequate. The question for consideration is: Is it likely to be worth while, or not, to go in now for an expenditure of another 70 or 80 lakhs of rupees—say half a million sterling—to be imposed as a burden on the trade of the next 60 or 70 years, for the sake of securing, say twelve years hence, quay accommodation for 6 or 8 vessels with all modern equipment as in the best of Ports. It is *not* at present a question whether this or that detail of design of shedding or of quay is the best design. Therefore when I estimate such a thing as shedding at so much per square foot I must not be asked to waste time with petty details about windows, floors, roofs, rooms, etc. I need show no more than the general area and the character of each, so as to arrive at a rate. The same thing with quays; only here, there being less local experience to go by, it has been necessary to estimate in greater detail.

10. *Advisable to use heavier wells than shown in the plates.*—It is necessary at this stage that I should explain that the design of the quays, as shown in the plates hereto appended, has been based on the use of a series of wells 18 feet thick for a height of 44 feet above possible sea-bed. This would be the usual thickness for such a retaining wall with 32 feet of water, at worst, against the front of it. In the design, however, to make all quite safe, provision was made for the use, behind the wells forming the quays, of a large quantity of rough stone filling, so as, to some extent, to modify, favourably, the pressure due to the sand behind the wells and of the sheds and traffic load on top of them. But, on reconsideration, it seems best that such an estimate as this should offer no grounds for suspicion of inadequacy; so an alternative design was got-out for using wells 20 feet thick instead of 18. This will be quite, or more than, ample. The extra cost involved is Rs. 2,64,000 net, there being no longer any need for the rough stone backing above referred to. The estimate therefore has been prepared to cover the extra cost of the stouter wells, but the general design, as shown in the plates, remains otherwise unaltered.

11. *Detailed designs will come later.*—Long before actual work begins on the suggested structure, complete detailed designs and estimates will have to be prepared, and the problem of how to work the traffic must be thoroughly gone into, from the points of view of (a) the steamer agent, (b) consignee and consignee, (c) the Port Trust who handle and deliver the cargo, (d) the railways and (e) Government, as represented by the Collector of Sea Customs. But the time has scarcely arrived for all this. The question for immediate consideration is: Is it worth while, at such and such a cost, to provide such and such facilities.

12. *Quay accommodation provided.*—There will in effect be three quays, to be called North quay, South quay, and Jetty quays. At either the North or the South quay three ships of 400 feet long can lie, or two ships of 480 feet long. At the Jetty quays only two ships up to 400 feet long can be accommodated. Say, at most, 8 moderate-sized ships. Besides this, one more can be given quay room at the old (closed) entrance, one on the new north arm, and one at the new screw-pile wharf for ships, now under construction. Also doubtless, if the new screw-pile ship wharf proves a success, a similar one will be built for wagon-loaded coal at the north groyne; and if this is done, 12 ships can be accommodated alongside of quays, simultaneously, at a pinch. Probably, however, half this number, or fewer, will be the usual average.

13. *New jetty in replacement of old screw pier.*—I have made a separate estimate for doing this alone. Needless to say I have taken the wells down the full depth, and

as these particular wells are the expensive ones, having to be founded in deep water, the estimate of the jetty is proportionately higher than the estimates for the north and south quays. From this partial estimate if those items be picked out that show the new jetty equipped only for barge work—because it will not be possible to dredge alongside of it, deep enough for ships, until some considerable part of the main quays shall have been finished—it will be found to cost 15 lakhs for the structure only and about 5 lakhs for partial equipment. In order to equip the jetty for cranes of small lift for barge work, I have allowed for the same cranes as we have used heretofore, and they will work cargo into a single storey shed. The sheds for the jetty, it will be seen, have been designed so as, eventually, to be double storied, and the big cranes, to be installed later, can lift high enough to put goods into the upper floor.

14. *Quay walls.*—For the design of the quay walls see paragraph 10. I make them rest on monolithic, double-octagonal wells. These wells will extend from one foot above high water mark to 12 feet below the 32 feet which may possibly be dredged hereafter, or to 14 feet beneath the 30-ft. dredging that will be done at first. On top of the wells the superstructure to carry the cranes will be built of masonry, rough rubble, mostly, of the stone now in place for the present revetment. The quay walls will be properly fendered and timbered, and will be provided with bollards as well as with hydraulic winches for handling vessels. They will be capped at level 12 feet above I.S.L.W.

15. *Founding the wells.*—All the 80 wells along the north and south quay line can be pitched on the sand by a simple enough contrivance, viz., by sending shorewards the results of the Madras' dredging, in floating pipes, so as to shallow up the site on which the wells must be pitched. This will make it unnecessary, so far as these wells are concerned, to have resort to heavy and expensive caissons. But *per contra* something has had to be allowed for the double dredging, for all sand sent shorewards for this purpose must be dredged out again. But the wells forming the walls of the jetty, surrounding the old screw pier, cannot be so pitched, because the old pier will have to be kept in use up to the end—so useful as it is. These wells will require to be pitched by means of caissons varying in depth from 12 to 28 feet. This adds greatly to the expense, and for only a temporary purpose, or as a means to an end. Apparently, however, it is inevitable.

16. *New shedding.*—The estimate shows a pair of double storey sheds on the central jetty, with a road and railway lines between them for cart and rail deliveries. It shows similar sheds in front of, that is on the eastern face of, the present steel sheds. It also shows some shedding on the north beach, but not much, because that beach must still to a great extent be devoted to the coal trade. The flat roofed masonry shedding will avail largely to save the present steel sheds from the force of severe storms. Provision has been made on the roofs of the permanent jetty sheds for offices for the port staff.

17. *Shedding on the jetty.*—The central jetty, which will be 233 feet wide by 500 feet long if the small wells are used, or 253 feet wide by 508 feet long if the large wells are used, is provided, as just explained, with two double-storey sheds, between which is a delivery road. The sheds provide an aggregate area of 82,000 square feet, or about the same as the whole of our existing dutiable import shed. But if the larger wells are used there will be room on the central jetty for some 20,000 feet extra floor space of shedding accommodation. Instead of being made of steel and tin roofed, they are solid, flat-roofed structures fit to stand any cyclone. Hydraulic lifts will enable goods to be passed between the lower and upper floors. The gantry cranes will be able to deliver on the ground outside the lower floor as well as on to a platform on the roof of the lower floor, for delivery into the upper floor, as desired. Goods so placed by the gantries will be hand-barrowed into the sheds, there will be no need to trolley them. But it may be that certain goods may have to be shifted from the central jetty to the inland sheds, and this has been provided for by leaving under the gantry cranes a roadway large enough for such goods loaded on pier trollies.

18. *Deliveries from and into jetty sheds.*—For delivery of goods into or out of the jetty sheds, whether by road or rail, there is a central 60 ft. road between the two sheds, and this is equipped with two mixed gauge lines of rails, one at each side, so that

either direct rail deliveries or cart deliveries may go on. Even when two rakes of wagons happen to be standing simultaneously on the delivery road, there will still be ample width for cart traffic.

19. *Office accommodation.*—At the outer and at the inner ends of the 500 lineal feet of double-storey shedding there will be third floors of dimensions suitable for the Port marine work, the occupants of the outer or easternmost building being the signal men and the pilot office and of the inner building the Deputy Port Conservator's and a traffic office. The Port offices will be in the most ideal position conceivable for doing business with shipmasters.

20. *New shedding on south quay.*—For the use of goods landed on the south quay we have the present lot of steel sheds. But as there is plenty of room to widen them on the east side, and as they are perhaps of somewhat inadequate strength if exposed to the attack of a really first-class storm, I have added, all along the east, or sea, face of them, another 40-ft. bay, but built of solid masonry, double storied and flat roofed, so as to shelter the present sheds. Lifts will connect the upper and lower floors. It seems possible that, ordinarily, the front section, 40 feet wide, may be reserved for export cargo. But that is a detail. The chief thing just now is to feel sure that the money provided in the estimate is not inadequate.

21. *New shedding on north quay.*—On the north quay I have provided a range of shedding of character similar to that of the shedding on the south quay. That is, 120 feet wide of steel shedding at the back and 40 feet wide of double-storied masonry shedding as a shelter in front.

22. *Area of shedding.*—The total area of shedding at present available—*vide* paragraph 27 of the Port Trust Administration Report for 1908-1909—is about 260,000 sq. ft. To this the suggested new shedding adds about 240,000 sq. ft.; so that, if it gets all the suggested shedding and keeps all its old shedding, the port will have some 500,000 square feet, or over 11 acres of shedding, instead of the present 6 acres. As time goes on, if this is considered too much, less of it may be built, and anyhow some of the old shedding will gradually die out of use, no doubt.

23. *Cranes.*—The estimate provides three 35-cwt. cranes for each of the eight ships that can lie alongside the quays. The cranes are more or less of the latest Calcutta pattern, and ought to plumb the hatches of the largest vessels likely to frequent the port for many years to come. Our present cranes will be disposed where they can deal with lightered cargo. For doubtless there will always be a great deal of lightering on the off side, and indeed it is most desirable that it should be so. The Calcutta cranes do not admit rolling-stock beneath their gantries, but it will be convenient at least to admit loaded trollies to pass beneath them here, where we are a bit cramped for room, and this will not cost much extra. Hydraulic power is provided for, as being more reliable in use in this country, where so few electrical experts of the working class are available.

24. *Craning cargo for vessels at the quays.*—The conditions for the working of the cranes are as follow. It will not be practicable for the big 35-cwt. gantry cranes to do all the work of all the ships. For iron and timber must go into the boat basin and therefore be lightered. Heavy goods such as railway materials, engines, machinery, pipes, etc., now dealt with on the south arm quay will probably continue so to be dealt with and, in that case, will ordinarily be lightered. Thus, even if a vessel comes alongside the new quay, all the above kind of cargo that is in her can, if desired, be put over her off side by her own tackle into lighters, thence to be landed either at the timber yard or at the iron yard in the boat basin, or at the machinery wharf at the south arm. For such vessels it will probably be found that the new 35-cwt. cranes will deal only with cargo that has to go into shed, as well as with anything they can lift that wants to go away in railway wagons direct.

25. *Craning cargo for vessels at moorings.*—But we must also provide for handling the cargo of vessels that will lie out at moorings instead of alongside the quays. All the cargo of such vessels will be lightered as at present, and such part of it as does not go into the boat basin or on the south arm wharf will have to be lifted by cranes like our present cranes, and room must be found for such cranes as well as for the lighters that they will serve.

26. *Ad interim working of cargo.*—A consideration which, necessarily, must influence the design very largely is that it is essential that provision should be made for the working of cargo, by means of lighters, during the years that must elapse before vessels of large tonnage can lie alongside the new quays. Also provision must be made for working cargo from lighters, whether of vessels moored outside or from the off side of vessels at the quays. Therefore I have furnished not only the central jetty but also part of the north and south quays with pedestal-cranes of our present type, spaced about 33 feet apart—that is, one over the centre of each well—for working cargo in and out of lighters. For several years—that is until its turn comes for gantry crane equipment and until dredging is completed—the jetty will be for use solely with lighters and must, therefore, be equipped with pedestal-cranes of small lift, of character similar to those on the recently constructed screw piers. Then, if the rest of the equipment of the jetty is so designed—and I have so designed it—that the large ship cranes may, when the time comes, work over the top of the small cranes, ships can in due course—a good many years hence—be worked alongside the jetty, and between whiles it can be used for lighters. Thus until vessels can lie alongside the central jetty—a matter possibly of eight or even ten years from now—that jetty will perform most valuable services, equipped as it will be with 24 pedestal 1-ton cranes, working into sheds on the jetty itself. But if necessary to do so, cargo can be trolled into any of the other sheds.

27. *Crane equipment at north and south quays.*—Before the central jetty can be made fit for ships, some part of the north and south quays must be finished, for without this it would not be possible to dredge close up to the central jetty. Therefore I have shown these parts of the north and south quays equipped with 12 one-ton pedestal cranes, for lighter and barge work. The big gantry cranes have been so located as to work right over the pedestal cranes, which, while the gantry cranes are working, will, ordinarily, be out of action, as being incapable of reaching over a ship's side. But if a ship is in a great hurry and puts cargo overside with her own tackle, some of the pedestal cranes can, if necessary, deal with it even while the gantry cranes are working.

28. *Dredging.*—This will be a very long and heavy job, unless—which seems unnecessary—the Trust goes in for the purchase of a new dredger. The Madras and the Triton can do it all between them, but it will take fully 10 years. As a fact it is going on even now, the Madras being employed in bringing the 30-ft. line of soundings westward to the place designed for it in conjunction with the revetment scheme. The rate inserted for this rather large item of the work is based on our knowledge of the annual cost of working our dredgers. I think I have allowed ample money for dredging in the estimate.

29. *Sequence of works.*—The central jetty will have to be put in hand first of all, then the north quay, and lastly the south quay. My reason for suggesting that the north quay be gone on with before the south quay is that the site of the latter, now and for some years ahead, is well equipped for the handling of lightered cargo. By the time ships can lie alongside the north quay and the northern side of the central jetty, it will begin to be necessary to dismantle the present screw-pile piers. These by that time will be anything from 10 to 15 years old, and they are not screwed deep enough to be left standing when the sea-bed they stand on shall have been dredged. My idea is to use their material for lining up the eastern side of the boat basin. By that time we shall have notified the oil people, under the terms of their lease, that they must shift off to the southward, and we shall have a fine space opposite the eastern side of the basin for working lightered cargo from, perhaps, a widened boat basin. Our present 26 one-ton cranes will stand all along the wharf to be so constructed. There will be a shed at the back of them, and any amount of work can be done there.

30. *Time for completion.*—According to my forecast of progress, the central jetty quays will be completed within four years from making a start, the north quay within say four years more, and the south quay say three years later. Total eleven years, or say twelve to finish all up. It is a big scheme and will, I think, be worth the cost, for undoubtedly our experience here is that trade responds readily to each new equipment or convenience afforded to it.

31. *Order of operations.*—The order in which the series of works will be carried out might be somewhat as follows:—

- First year.*—Collect plant and start the wells at north side of the central jetty.
- Second year.*—Complete north side of jetty and equip it with pedestal cranes.
- Third year.*—Complete south side of jetty and get on with its equipment.
- Fourth year.*—Complete equipment of jetty and start wells of north quay.
- Fifth year.*—Get on with north quay and partly equip it with pedestal cranes.
- Fifth year.*—Top walls and equipment of north quay.
- Sixth year.*—Complete north quay and go on with its sheds and equipment.
- Seventh year.*—Equipment of north quay and begin wells of south quay.
- Eighth year.*—Equipment of north quay and wells of south quay in progress.
- Ninth year.*—North quay equipment and structure of south quay completed.
- Tenth year.*—Shedding and equipment of south quay.
- Eleventh year.*—South quay and equipment of jetty for steamers completed.

32. *Practicable speed of expenditure.*—All this time, dredging will be going on, for say 11 years, at Rs. 86,000 a year. There would not be much use going faster than the above programme because the dredging is the governing factor, and it will be no use having the quays ready unless the harbour is dredged deep enough to use them for shipping. Needless to say, whoever carries out this work will have his own ideas about what exactly to do in each year, so the above forecast must not be understood as anything more than a rough guess at how fast the loan money may, with advantage, be supplied. For on this depends the Trust's probable ability or inability to afford the suggested expenditure. In a general way our experience here is that, in so cramped a place, and with all his revenue work as well, and having to keep trade moving all the time, the Trust's engineer cannot spend much more than six to eight lakhs a year on such works as those suggested.

33. *Expenditure in successive years.*—In view of the overlapping of some of these works over others, and of the difficulty of going ahead in so cramped a place in such a way as not to interfere with current traffic, it looks as if the following schedule might, more or less, exhibit the order in which expenditure would be incurred in a series of years. The figures in the schedule are in lakhs and decimals.

Section of work.	Dredg- ing.	Central jetty quays.			North quay.			South quay.			Grant in succe- ssive years.
		Struc- ture.	Sheds.	Equip- ment.	Struc- ture.	Sheds.	Equip- ment.	Struc- ture.	Sheds.	Equip- ment.	
Estimated cost.	9.45	15.42	5.77	3.93	10.68	2.27	6.32	9.61	5.01	4.54	73.00
1st year	0.85	4.15	..	..	..	..	..	..	..	..	5.00
2nd "	0.86	6.14	..	..	..	..	..	..	..	..	7.00
3rd "	0.86	5.13	2.01	..	..	..	..	..	..	..	8.00
4th "	0.86	..	3.76	1.00	2.38	..	..	..	..	..	8.00
5th "	0.86	..	..	1.43	4.00	1.00	0.71	..	..	..	8.00
6th "	0.86	..	..	..	4.30	1.27	1.57	..	..	..	8.00
7th "	0.86	..	..	..	..	..	2.04	4.10	..	..	7.00
8th "	0.86	..	..	..	..	..	2.00	4.00	0.14	..	7.00
9th "	0.86	..	..	..	..	..	..	1.51	3.00	0.63	6.00
10th "	0.86	..	..	1.00	..	..	..	..	1.87	1.27	5.00
11th "	0.86	..	..	0.50	..	..	..	..	..	2.64	4.00

34. *Extinguishing the proposed debt.*—In attempting to make a forecast of future expenditure from our revenues, as the result of the suggested new indebtedness, it is necessary to bear in mind that, however equitable it may be to impose the burden of the cost of some of the proposed works on future generations, there are others of not quite first-class enduring character which may, and indeed to some extent practically must, be replaced within a comparatively brief term of years. As illustrations I may instance quay walls with, as may fairly be presumed, a life of

century or two, while at the opposite end of the scale are cranes which are almost certain to have to be renewed in 30 or 40 years. Intermediate between the two may be classed such structures as sheds, roads, etc.; for changes of traffic conditions or of systems of working may necessitate their renewal or shifting at a comparatively early date. Appendix II attempts to separate the three classes of works, bringing them out, in round figures at, say, Rs. 45 lakhs, 13 lakhs and 15 lakhs respectively. It seems fair to arrange for the amortisement of these three parts of the proposed loan in 60, 45 and 30 years, respectively. The calculation for the equated monthly payment of principal and interest to kill off these proposed loans in the times suggested gives the following results:—

To pay off 45 lakhs in 60 years requires a monthly payment of ...	Rs.	16,503
" 13 " 45 " " " " "	"	5,195
" 15 " 30 " " " " "	"	7,161
Total, monthly payment ...	"	28,859

But to avoid complication it may be thought advisable to pay off the whole three loans in a period which works out at an average burden about equivalent to the sum of the above three. This will require a monthly payment of Rs. 28,731, or say, Rs. 3,25,000 per annum (12 payments), for a period of 47 years, and this last is the figure made use of in the financial forecast now presented in Appendix V. This burden will come on the Trust in the twelfth year after commencement of operations. That is, if all goes on as forecasted, the burden will begin in the year 1922–1923. If, however, the Imperial Government can be persuaded to give the Trust a free grant of Rs. 20 lakhs, the burden of repayment will be at the rate of Rs. 20,860 per mensem for 47 years, or in each year Rs. 2,50,000, and this last is the figure made use of in the forecast presented in Appendix VI.

35. *Effect on Port and Harbour dues.*—Perhaps the consideration which of all others will be of immediate interest to merchants and steamer agents is whether the effect of the new proposals, if agreed to, will be to impose a burden on the trade of the port before the arrival of the additional facilities which seem likely adequately to compensate for such burden. Any doubt there may be on this point ought to disappear on a careful study of the forecast forming Appendix V which purports to show what the Trust's balances seem likely to be if all goes well with the trade of the port on anything like the scale of its well-doing up to date. During the first ten years of the new loan there will be payment of interest but no repayment of capital on its account. This, apparently, the Trust will be able to afford quite well without raising dues. But gradually, as facilities come into use, such as the central jetty first, then the north quay and finally the south quay, it will be fair to recover additional dues not only from steamers using the quays on their registered tonnage, but also from steamers for lifting their cargo instead of letting them do it themselves. These dues on steamers are included, as explained further on, in the Port Fund surplus, contributed to the Port Trust Account as shown in column 4 of the statement. In column 3 are shown the profits on the harbour dues, as distinguished from port dues, that will be levied per ton of cargo handled over the quays—that is, on cargo that is saved the cost of lighterage—at an assumed rate of 8 annas per ton. It will be seen that the effect is to make the Trust's finances quite solvent and even flourishing, so much so that it is doubtful if it will be necessary to increase harbour dues on goods by anything like 8 annas. I however leave it to stand at this, for doubtless money will by that time be wanted for many things. I hope that the general effect of the forecast, so explained, will be to satisfy the minds of merchants and steamer agents that there will be no necessity to raise dues, either on registered tonnage or on goods imported and exported, until facilities worth paying for shall have been provided.

36. *Additional Harbour dues when quays come into use.*—If we assume that enhanced dues are put on goods—as distinguished from registered tonnage of vessels—passing over the quays, beginning with the year 1919–20, and if we look at the curve of improvement of tonnage given in the Diagram, Plate I, we find that at the year of starting to levy these dues there will probably be a tonnage of 910,000 and at the last year in the diagram 1,100,000 tons. Only a part of all this tonnage, perhaps

a third of the whole, will pass over the quays, say, 303,000 tons in the first year of the eleven and 366,000 tons in the last year. Eight annas per ton put on this tonnage, in lieu of saved cost of lightering, would give the Trust an additional revenue rising from Rs. 1,50,000 in the first year to Rs. 1,80,000 in the last year. But as the quays will only come gradually into full use, we may assume that only Rs. 50,000 will be collected in the first year of the ten and Rs. 2,00,000 in the last year from this source, and that half these additional collections will be net profit. These extra collections are indicated by the curve FF on the diagram. But it seems scarcely necessary to explain that this kind of forecast pretends rather to qualitative than to quantitative truth.

37. *Port dues at Madras and other ports compared.*—In considering the necessity for levying additional dues when the quays begin to come into use, and the amount that it may be necessary to levy, it must be borne in mind that there is one class of such dues that falls directly on the cargo imported and exported at the port, while there is another class of dues that falls on the ships and only indirectly on the cargo through the freight charge. Dues of the first kind are levied under the authority of the Madras Port Trust Act, those of the second kind, here, under that of the Indian Ports Act. Under the latter head fall such dues as cover the cost of pilotage, mooring, hospital dues, use of wharves, port dues, fees for use of wharf cranes, warping fees, dock dues, and such like. These differ in every port according to the circumstances of the port. They also differ according to the facilities provided. Some of them are levied per registered ton, others per day, and so on. I have tried to ascertain what these Port Fund fees amount to in several Indian ports, in order to compare them with those levied in Madras. But it has been necessary to make some assumptions if a comparison of any value is to be made. The average tonnage of some 14,000 vessels of all sorts of tonnage that have made use of the port in the last 21 years has been 1,900 tons. But the average tonnage of ocean-going steamers that have made use of the port in the last 5 years has been 2,565 tons. A large percentage, however, of these are coasting steamers of comparatively small tonnage so I think 3,500 tons not unfair for vessels likely to use the quays for coal and general cargo. I have assumed therefore, in every case, that the tonnage of the vessel is 3,500 registered, that she uses wharves and cranes when available, staying seven days in the port. On these assumptions the result is as follows:—

P O R T .	Dues on registered tonnage of shipping.	
	With pilotage. pies per r. ton.	Without pilotage. pies per r. ton.
Calcutta	160	85
Rangoon	127	99
Bombay	37	24
Karachi	73	60
Chittagong	113	89
Madras	22	18

38. *Future Port dues when quays come into use.*—At present Madras port is devoid of wharves, as well as of cranes fit to lift cargo out of vessels. Therefore it is equitable that, for the present, its charges per registered ton should be very low. But it seems only fair that, when the wharves and ship cranes come into use, some such charges as the following should be leviable:—

(a) *Port dues.*—Those at Calcutta are 4 annas per ton, at Bombay 1 anna, at Karachi 3 annas, at Rangoon 3 annas, and at Chittagong 4½ annas. Here at present they are half an anna per ton. They may be raised to three annas per ton registered.

(b) *Hospital dues.*—These need not be charged here any more than heretofore. At Calcutta they are 9 pies, and at Chittagong 1 anna, per ton.

(c) *Mooring.*—This includes use of harbour master, warping alongside, etc., for which, for a 3,500 ton vessel, the charges elsewhere are, Calcutta Rs. 150, Karachi Rs. 50, Rangoon Rs. 112, and Chittagong Rs. 70. The charge here for vessels using the quays may be 6 pies per ton, or for a 3,500 ton vessel, Rs. 110.

(d) *Wharfage*.—The charges elsewhere are, Calcutta Rs. 35 per day, Karachi Rs. 20, Rangoon Rs. 50, Chittagong Rs. 35—all per day. The charge here may be 2 pies per ton per day, or for a 3,500 ton vessel, say Rs. 36 per day.

(e) *Cranage*.—The charges at other ports per crane per day are: Calcutta Rs. 5, Karachi Rs. 6. The charge here may be fixed tentatively at Rs. 6 per crane per day, because coal is dear.

(f) *Pilotage*.—This may remain unaltered, that is Rs. 70 for a 3,500 ton vessel. The conditions of pilotage will not have changed appreciably.

39. *Estimate of average rate of future Port Dues*.—Thus we have the following estimate of what it will be fair to charge the average ship:—

(a) Port dues 3,500 tons at 3 annas	...	...	Rs.	656
(b) Hospital dues, Nil	...	...	"	...
(c) Harbour Master, warping, etc.	...	...	"	110
(d) Wharfage, 7 days at Rs. 36	...	...	"	252
(e) Cranage, three cranes, 7 days at Rs. 6	...	...	"	126
(f) Pilotage, as at present	...	...	"	70

Total Rs. 1,214 or at the rate of 66 pies per ton registered of shipping making use of the wharves; or, omitting pilotage, 46 pies, which is lower than is charged at any of the ports above quoted, except Bombay.

40. *Available Port Fund surplus*.—An estimate may now be made of the Port Fund surplus likely to be made available in enhancement of the Port Trust's balances. Receipts from the Pilotage Fund will not be available, for the whole of the profit on pilotage will have to be kept in reserve to meet the requirements of the new conditions under which the pilotage staff has become pensionable. I find that in a spell of 21 years over 26 million tons of shipping using the port have paid at the rate of 18.38 pies per ton as Port dues of all descriptions except pilotage. I find that working expenses have been 64 per cent. of gross receipts, so that the net profit to the Port Trust has been at the average rate of 6.62 pies per ton. If this rate be applied to the curve of increasing tonnage C.C. on the diagram, between now and the year—say 1919–1920—when the quays will come into use, it will give the curve E.E₁, from which the figures in column 4 of the forecast for the ten years between now and 1919–1920 have been supplied. If we assume that, beginning at 1919–1920, one-third of the registered tonnage given on curve C.C. will pay at the enhanced rate, 46 pies, and the remaining two-thirds will pay as heretofore at an average rate of, say, 18 pies, and that working expenses will continue at 64 per cent. of gross receipts—very rough assumptions, doubtless, but good enough for the present rough purpose—we get the figures given in column 4 of the forecast for the years 1919–20 to 1929–30, and the curve E₁ E₂.

41. *The Forecasts*.—Something must now be said about the two financial forecasts offered as Appendices V and VI. The first is based on the assumption that Government will not, and the second on the assumption that they will, give the Port Trust a free grant of Rs. 20 lakhs. Both forecasts are identical up to column 11. The curve A.A. on diagram I is the basis of the figures in column 2, and judging from past results I do not think that this curve errs on the side of over-hopefulness. Madras trade has, heretofore, responded promptly to the provision of facilities for its better handling. The figures given in column 4, for Port Fund contribution to the Port Trust Revenue Account, are based on the considerations dealt with in paragraph 40. The temporary loan sanctioned in G.O., No. 417 F., dated the 7th September 1908, is shown in column 5 and in column 9 is shown as repaid. The figures for working expenses given in column 7 are taken at one-half the harbour dues given in column 2. In the last five years if the expenditure on *dredging* be omitted—and it will be shown in the Capital instead of the Revenue Account once the proposed new works begin, during the period of their construction—working expenses have averaged 40.53 per cent. of receipts. To allow for the extra expenses foreshadowed in paragraph 52 of the Administration Report for 1908–1909, I have raised the percentage to 50 per cent. which seems safe. The figures shown in column 10 for Revenue contribution to Capital will probably suffice, at least while the proposed new works are in progress.

42. *Forecast if the full 73 lakhs is borrowed*.—The conclusion arrived at on inspection of Appendix V is that the Trust's balances will probably tend to grow inconveniently low as soon as it becomes necessary to begin to pay off the 73-lakh loan, and that in order to counteract this tendency it will be necessary to impose port dues on the registered tonnage using the quays and harbour dues on the goods passing over them. The result is the satisfactory balance shown in column 14.

43. *Forecast if only 53 lakhs is borrowed*.—Similarly as regards Appendix VI. Only in this case the Trust's balances do not show any tendency to run down to a dangerously low figure, and the imposition of port and harbour dues for vessels and goods, respectively, using the quays shows so needlessly high a balance in column 14 that it may, after all, not prove necessary to raise any of the dues by an appreciable percentage; unless for the purpose of improving, even still further, the conditions of the Port—a purpose which need not come under consideration in connection with the subject of the present memorandum.

44. *Early replacement of old pier a matter of urgency*.—I must now warn the Port Trust Board and the Government of Madras that the old ocean screw pile pier has come pretty near the end of its safe life. It is, therefore, a matter of some urgency that the Trust should somehow arrange for its early replacement—a replacement which, if carried out as an instalment of the full 73-lakh scheme, may cost some Rs. 15 lakhs in round figures for the quays and say Rs. 5 lakhs for their equipment on a scale suitable for lightered traffic; or a total of Rs. 20,00,000—a sum which ought to be arranged for so as to become available in a period of three years, and the sooner the better.

45. *Conclusion*.—The capital outlay that will have been incurred on Madras Harbour by the end of 1910–1911 will have amounted to Rs. 2,38,38,000 of which Rs. 98,30,000 has been a free grant from Government. If the ship quays now suggested are carried to completion at a cost of Rs. 73,00,000, the entire cost to the Port Trust of the harbour and of all its equipment will have been Rs. 2,13,00,000. Towards the repayment, with interest, of the debt for which the Trust is responsible, shipping pays at the average rate of 18 pies per ton registered, exclusive of pilotage and all services rendered, whilst in the scheme now put forward it is proposed that shipping using the new quays should pay 46 pies, or say 4 pence, per ton registered. At present goods pay at the average rate of Rs. 1.35 per ton, whilst in the scheme now put forward it is suggested that in future—that is when the quays come into use—goods using the quays should pay at the average rate of Rs. 1.35 per ton, this last rate being of course graded to suit the value of the goods handed—e.g., coal will not pay as high an increment over present rates as will be paid by, say, grain or piece-goods. That these increments of dues, on shipping and on goods respectively, will not be onerous may be gathered from the fact that they are for additional services actually rendered, which, in the case of shipping, will give a considerably quicker discharge and in the case of goods will relieve the owner of much of the present heavy cost of lighterage. Thus, on the whole, it does not seem that the result of the improvement of the conditions of the port will be to affect trade adversely, but rather the contrary. For with quicker despatch freights must drop in the long run, and with better and quicker handling insurance ought to drop, and anyhow the cost of lighterage will be saved. At least to the vessels and to their cargo using the quays; for, as will have been understood, the forecast made in this memorandum is based on the hypothesis that only those vessels and those goods that avail themselves of the new facilities will have to pay the extra port and harbour dues. Thus I think I may fairly claim that the scheme on the whole is a sound scheme—assuming always the reasonableness of the forecast curves on the diagram given on plate I—and that it may be recommended with some confidence, as being likely to improve trading conditions all round, for the Port of Madras, as expediting the movement of goods through a tight place, at no enhanced cost beyond what, in one form or another, is now incurred, whether in cost of lighterage or in delay and expense to shipping. As such I leave it in the hands of the Port Trust Board, without any desire actively to press for its acceptance. For I can scarcely hope to be interested in it personally, beyond, perhaps, its inception as a scheme to be taken in hand when conditions are believed to be favourable.

1st September 1909.

FRANCIS J. E. SPRING,
Engineer-Chairman, Madras Port Trust.

APPENDIX I.

ESTIMATE I.

CENTRAL JETTY QUAYS.

No. of item.	Particulars.	Quantity.	Unit.	Rate.		Amount.
				Rs.	Per	Rs.
Work of 1st class permanence.						
1	Plant for handling caissons	..	..	..	lump sum.	50,000
2	Do. well sinking	..	..	..	Do.	25,000
3	Do. stone crushing	..	..	..	Do.	10,000
4	Do. workshop and general	..	..	..	Do.	15,000
5	Well iron-work	2,250	tons.	275	tons.	6,18,750
6	Well steining in cement concrete ..	522,000	cb. ft.	58	100	3,06,820
7	Do. sinking	903,000	Do.	12	100	1,08,380
8	Do. filling, concrete	187,000	Do.	50	100	93,500
9	Do. do. ballast	187,000	Do.	10	100	18,700
10	Sealing piles	2,300	lin. ft.	5	lin. ft.	11,500
11	Masonry in cement, own stone	45,000	cb. ft.	40	100	18,000
12	Do. mortar do.	77,000	Do.	24	100	18,480
13	Top capping of quays	22,000	sq. ft.	0.5	lin. ft.	11,000
14	Filling between quay walls, stone ..	680,000	cb. ft.	50	1,000	34,000
15	Do. do. earth	1,400,000	Do.	12	1,000	16,800
16	Add. extra for larger wells	..	..	..	lump sum.	1,10,000
17	Dredging	3	years.	65,000	year.	1,95,000
18	Establishment	38	months.	1,000	month.	38,000
19	Contingencies	..	..	..	lump sum.	38,090
Total ..		..	..	..	..	17,37,000
Work of 2nd class permanence.						
19	Shedding, ground floor	60,500	sq. ft.	5	sq. ft.	3,02,500
20	Do. 1st floor	46,500	Do.	4	Do.	1,86,000
21	Do. office	19,500	Do.	3	Do.	58,500
22	Roads, metalled, 1st class	70,000	Do.	18	100	12,600
23	Establishment	9	months.	1,000	month.	9,000
24	Contingencies	..	..	..	lump sum.	8,400
Total ..		..	..	..	..	5,77,000
Work of 3rd class permanence.						
25	Railway lines, mixed gauge	4,000	lin. ft.	7	lin. ft.	28,000
26	Metre gauge lines for truck service ..	2,000	Do.	3	Do.	6,000
27	Switches	20	No.	2,000	each.	40,000
28	Turn-tables	2	Do.	2,000	Do.	4,000
29	Bollards	8	Do.	500	Do.	4,000
30	Fendering	1,200	lin. ft.	15	lin. ft.	18,000
31	Trolleys, metre	36	No.	600	each.	21,000
32	Hand trucks	..	..	..	lump sum.	2,000
33	Hydraulic equipment as per estimate IV ..	..	..	..	..	2,50,000
34	Establishment	9	month.	1,000	month.	9,000
35	Contingencies	..	..	..	lump sum.	10,400
Total ..		..	..	..	..	3,93,000

APPENDIX I—cont.

ESTIMATE II.

NORTH QUAY.

No. of item.	Particulars.	Quantity.	Unit.	Rate.		Amount. Rs.
				Rs.	Per	
<i>Work of 1st class permanence.</i>						
1	Plant for well sinking	..	..	..	lump sum.	25,000
2	Floating pipes for dredger " Madras " ..	..	..	..	Do.	50,000
3	Stone-crushing plant	..	..	..	..	10,000
4	Workshop plant	..	..	..	..	5,000
5	Locomotive and other plant	..	..	..	..	32,000
6	Well iron-work	375	tons.	275	tons.	1,03,125
7	Well steining in cement concrete ..	572,000	c. ft.	58	100	3,31,760
8	Do. sinking	976,000	do.	12	100	1,17,120
9	Do. filling, concrete	202,000	do.	50	100	1,01,000
10	Do. do. ballast	202,000	do.	10	100	20,200
11	Sealing piles	1,800	lin. ft.	5	lin. ft.	9,000
12	Masonry in cement, own stone	50,000	c. ft.	40	100	20,000
13	Do. mortar do.	87,000	do.	24	100	20,880
14	Top capping of quay	25,000	sq. ft.	0.5	sq. ft.	12,500
15	Filling, back of quay, stone	1,080,000	c. ft.	50	1,000	54,000
16	Do. of sand by dredging	1,000,000	do.	15	1,000	15,000
17	Add extra for larger wells	..	..	..	lump sum.	77,000
18	Dredging	5	year.	75,000	year.	3,75,000
19	Establishment	32	month.	1,000	month.	32,000
20	Contingencies	..	..	..	lump sum.	32,415
Total ..		..	..	..	..	14,43,000
<i>Work of 2nd class permanence.</i>						
21	Shedding, ground floor	21,000	sq. ft.	5	sq. ft.	1,05,000
22	Do. front floor	21,000	do.	4	do.	84,000
23	Roads, metalled, first-class	1,50,000	do.	18	100	27,000
24	Establishment	5	month.	1,000	month.	5,000
25	Contingencies	..	..	..	lump sum.	6,000
Total ..		..	..	..	..	2,27,000
<i>Work of 3rd class permanence.</i>						
26	Shedding, steel	61,000	sq. ft.	4	sq. ft.	2,44,000
27	Railways, new, mixed gauge	3,000	lin. ft.	8	lin. ft.	24,000
28	Metre gauge lines for truck use	1,000	do.	3	do	3,000
29	Bollards	12	No.	500	each.	6,000
30	Fendering	1,400	lin. ft.	15	lin. ft.	21,000
31	Trucks, metre gauge	36	No.	600	each.	21,600
32	Hand trucks	..	..	..	lump sum.	2,000
33	Hydraulic equipment as per estimate IV ..	..	..	..	..	2,80,000
34	Establishment	16	months.	1,000	month.	16,000
35	Contingencies	..	..	..	lump sum.	14,400
Total ..		..	..	..	..	6,32,000

APPENDIX I—cont.

ESTIMATE III.

SOUTH QUAY.

No. of item.	Particulars.	Quantity.	Unit.	Rate.		Amount.
				Rs.	Per	Rs.
Work of 1st class permanence.						
1	Plant	..	..	..	lump sum.	20,000
2	Well iron-work	375	tons.	275	ton.	1,03,125
3	Well steining in cement concrete	572,000	c. ft.	58	100	3,31,760
4	Do. sinking	976,000	Do.	12	Do.	1,17,120
5	Do. filling concrete	202,000	Do.	50	Do.	1,01,000
6	Do. do. ballast	202,000	Do.	10	Do.	20,200
7	Sealing piles	1,800	lin. ft.	5	lin. ft.	9,000
8	Masonry in cement, own stone	50,000	c. ft.	40	100	20,000
9	Do. mortar do.	87,000	Do.	24	Do.	20,880
10	Top capping of quays	25,000	sq. ft.	0.5	sq. ft.	12,500
11	Filling back of quays, stone	1,080,000	c. ft.	50	1,000	54,000
12	Do. do. sand dredged	1,000,000	Do.	15	Do.	15,000
13	Add extra for larger wells	..	..	..	lump sum.	77,000
14	Dredging	5	years.	75,000	year.	3,75,000
15	Establishment	30	months.	1,000	month.	30,000
16	Contingencies	..	..	..	lump sum.	29,415
Total ..		..	..	..	..	13,36,000
Work of 2nd class permanence.						
17	Shedding, ground floor	50,000	sq. ft.	5	sq. ft.	2,50,000
18	Do. first floor	50,000	Do.	4	Do.	2,00,000
19	Roads, metalled, 1st class	150,000	Do.	18	100	27,000
20	Establishment	12	months.	1,000	month.	12,000
21	Contingencies	..	..	..	lump sum.	12,000
Total ..		..	..	..	..	5,01,000
Work of 3rd class permanence.						
22	Railways, new, mixed gauge	3,000	lin. ft.	8	lin. ft.	24,000
23	Metre gauge lines for trucks	1,000	Do.	3	Do.	3,000
24	Bollards	12	Do.	500	Do.	6,000
25	Fendering	1,400	lin. ft.	15	lin. ft.	21,000
26	Shifting present piers to boat basin	..	..	..	lump sum.	1,00,000
27	Shifting lines and sidings	4,000	lin. ft.	2	lin. ft.	8,000
28	Hydraulic equipment as per estimate IV	..	..	..	..	2,70,000
29	Establishment	11	months.	1,000	month.	11,000
30	Contingencies	..	..	..	lump sum.	11,000
Total ..		..	..	..	..	4,54,000

APPENDIX I—concl'd.

SUPPLEMENTARY ESTIMATE, IV, FOR HYDRAULIC EQUIPMENT.

Number of item.	Particulars.	Quantity.	Unit.	Rate.		Amount.	Appropriated to		
				Rs.	Per	Rs.	Estimate I.	Estimate II.	Estimate III.
1	Steam pump, to work at 750 lb. pressure, delivering 550 gallons per minute.	1	No.	80,000	one.	80,000	20,000	30,000	30,000
2	Boilers, set	1	set.	18,000	set.	18,000	6,000	6,000	6,000
3	Accumulator	1	No.	9,000	one.	9,000	3,000	3,000	3,000
4	Feed tanks	1	"	3,000	"	3,000	..	3,000	..
5	Erecting pumps, etc., in power house ..	..	..	..	L.S.	4,000	2,000	1,000	1,000
6	" boilers	..	..	..	..	10,000	4,000	3,000	3,000
7	Power house	8,000	sq. ft.	6	sq. ft.	48,000	18,000	15,000	15,000
8	Piping and all connections	6,000	lin. ft.	11	lin. ft.	66,000	40,000	18,000	10,000
9	" laying, in drain, etc.	6,000	"	4	"	24,000	16,000	4,000	4,000
10	Hydraulic gantry cranes, 35 cwt. ..	24	No.	12,000	each	2,88,000	72,000	1,08,000	1,08,000
11	Erecting	24	"	1,000	"	24,000	8,000	8,000	8,000
12	Pedestal 1 ton cranes	36	"	3,000	"	1,08,000	36,000	36,000	36,000
13	Erecting	36	"	250	"	9,000	3,000	3,000	3,000
14	Hydraulic 5-ton capstans	20	"	4,000	"	80,000	16,000	32,000	32,000
15	Erecting	20	"	500	"	10,000	2,000	4,000	4,000
16	Lifts, hydraulic	4	"	3,000	"	12,000	2,000	5,000	5,000
17	Erecting	4	"	500	"	2,000	..	1,000	1,000
18	Painting	..	..	..	L.S.	5,000	2,000	2,000	1,000
Total ..						8,00,000	2,50,000	2,80,000	2,70,000

APPENDIX II.

ABSTRACT OF ESTIMATES I, II AND III.

Particulars.	Estimate I.	Estimate II.	Estimate III.	Total.
<i>Order of permanence.</i>				
	RS.	RS.	RS.	RS.
Works of 1st class permanence	17,37,000	14,43,000	13,36,000	45,16,000
" 2nd	5,77,000	2,27,000	5,01,000	13,05,000
" 3rd	3,93,000	6,32,000	4,54,000	14,79,000
Total ..	27,07,000	23,02,000	22,91,000	73,00,000
<i>Abstract of estimates.</i>				
Quays proper	14,66,000	10,02,000	9,01,000	33,69,000
Dredging	1,95,000	3,75,000	3,75,000	9,45,000
Sheds	5,47,000	4,38,000	4,50,000	14,30,000
Roads and railings	91,000	54,000	54,000	1,99,000
General equipment	46,000	51,000	27,000	1,24,000
Fixed crane equipment, say	1,00,000	75,000	75,000	2,50,000
Gantry crane	1,50,000	2,05,000	1,95,000	5,50,000
Shifting old structures	..	..	1,08,000	1,08,000
Establishment	56,000	58,000	53,000	1,67,000
Contingencies	56,000	54,000	53,000	1,63,000
Totals ..	27,07,000	23,02,000	22,91,000	73,00,000

Particulars.	Estimated cost.	Length of quay.	Rate per lin. feet.
<i>Unit cost of quays.</i>			
	RS.	FEET.	RS.
Central jetty quays	15,43,000	1,271	1,214
North and south quays	19,98,000	2,732	731
All the quays, average	35,41,000	4,003	885

NOTE.—The cost of the quays is got from the estimates by deducting from the total for *work of first-class permanence*, the items *dredging*, *establishment*, and *contingencies*, and then adding the proportionate share of the latter two items.



APPENDIX III.

STATISTICS OF THE TRADE AT MADRAS PORT FOR 21 YEARS.

Year.	Imports.	Exports.	Total.	Number of vessels.	Registered tonnage.	Receipts per registered ton.
	TONS.	TONS.	TONS.		TONS.	PIES.
1888-1889	201,597	89,003	290,600	630	921,814	30.60
1889-1890	246,659	112,525	359,184	681	1,021,537	22.15
1890-1891	288,537	103,435	391,972	753	1,026,850	23.02
1891-1892	347,401	88,939	436,340	852	1,248,324	20.62
1892-1893	277,843	85,938	363,781	731	1,156,233	19.39
1893-1894	285,251	98,660	383,911	752	1,255,201	19.18
1894-1895	285,276	104,188	389,464	725	1,174,582	19.41
1895-1896	330,697	99,074	429,771	742	1,225,426	19.77
1896-1897	385,605	102,941	488,546	767	1,243,423	19.88
1897-1898	441,926	81,830	523,756	713	1,249,316	18.23
1898-1899	471,804	81,265	553,069	843	1,139,910	18.76
1899-1900	401,464	105,432	506,896	846	1,097,277	20.28
1900-1901	Tonnage in these years is not available.			595	1,120,960	21.03
1901-1902				559	1,191,044	18.37
1902-1903				600	1,223,686	14.98
1903-1904				551	1,374,655	14.50
1904-1905	431,870	117,757	549,627	572	1,443,863	14.25
1905-1906	471,918	106,576	578,494	620	1,519,248	13.41
1906-1907	410,365	112,307	522,672	567	1,453,997	16.48
1907-1908	493,002	128,512	621,514	664	1,585,245	15.60
1908-1909	604,669	132,118	736,787	647	1,694,610	15.55
1909-1910	629,871	135,835	765,706			
					26,367,211 tons.	pies 18.38 per average registered ton.

APPENDIX IV.

RECEIPTS AND EXPENDITURE OF THE MADRAS PORT FUND FOR 21 YEARS.

Years.	Receipts, ordinary.	Expenditure, ordinary.	Years.	Receipts, ordinary.	Expenditure, ordinary.
	RS.	RS.		RS.	RS.
1888-1889	1,46,901	66,686	1889-1900	1,15,926	71,133
1889-1890	1,17,884	70,649	1900-1901	1,22,816	69,322
1890-1891	1,23,116	64,799	1901-1902	1,13,991	59,219
1891-1892	1,34,045	76,976	1902-1903	95,475	61,630
1892-1893	1,16,765	84,858	1903-1904	1,04,450	59,824
1893-1894	1,25,363	59,924	1904-1905	1,07,195	68,269
1894-1895	1,18,779	72,272	1905-1906	1,06,112	1,10,854
1895-1896	1,26,199	91,093	1906-1907	1,24,788	1,10,929
1896-1897	1,28,752	76,941	1907-1908	1,27,977	1,19,169
1897-1898	1,18,833	76,627	1908-1909	1,37,216	81,268
1898-1899	1,11,349	70,967			
			Total	25,23,732	16,23,404

Note.—Expenditure about 64 per cent. of receipts.

APPENDIX V.

Forecast showing the probable financial position of the Madras Port Trust, up to the year 1929-30, on the assumption that it is decided to borrow the entire sum, Rs 73 lakhs, necessary for constructing ship wharves and to raise dues when requisite. The 73-lakh loan to be repaid by equated monthly payments of principal and interest in 47 years.

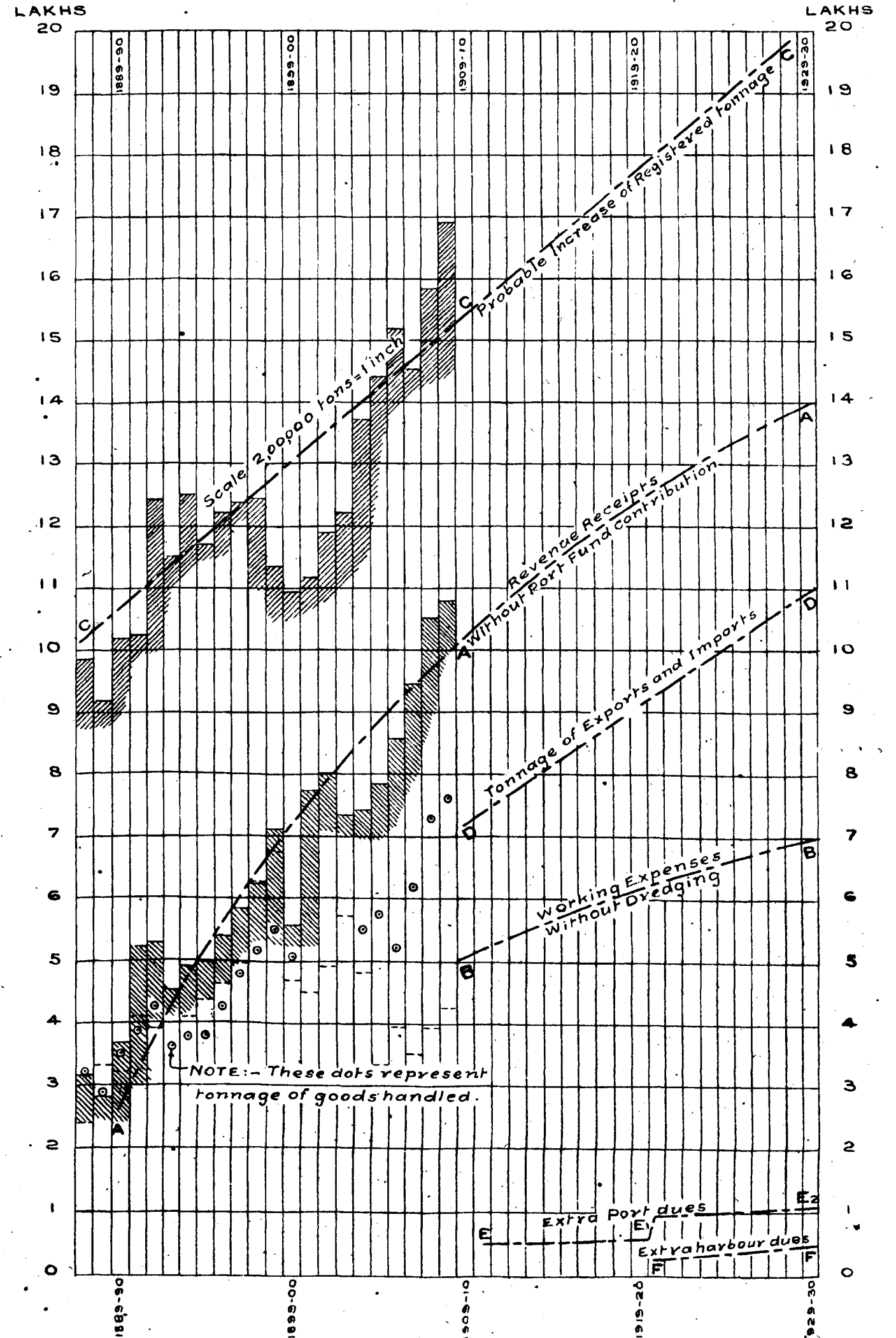
Year.	Incomings.				Outgoings.				State of Trust balance.				Year.	
	Gross revenue receipts.	Additional Harbour dues on goods passing over quays.	Port fund contributions.	Temporary loan.	Total incomings.	Working expenses on account of column 2.	Old loan repaid with interest.	Harbour extension loan and temporary loan, column 5, repaid with interest.	Revenue contribution to capital.	Total outgoings.	Trust's balances in successive years based on columns 2 to 11.	New 73-lakh loan, interest and repayment.		Trust's balances, column 12 modified by column 13.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1904-1905	8,65,000	..	..	..	8,65,000	4,63,000	2,73,000	..	1,20,000	8,65,000	8,65,000	..	8,85,000	1904-1905
1905-1906	9,48,000	..	20,000	..	9,68,000	3,76,000	2,03,000	2,000	2,76,000	8,57,000	8,94,000	..	8,94,000	1905-1906
1906-1907	10,62,000	..	..	..	10,62,000	5,62,000	2,03,000	33,000	7,76,000	15,74,000	10,05,000	..	10,05,000	1906-1907
1907-1908	10,80,000	..	..	..	13,50,000	5,14,000	2,03,000	78,000	6,66,000	14,00,000	4,83,000	..	4,83,000	1907-1908
1908-1909	10,30,000	..	70,000	2,00,000	13,83,000	5,07,000	2,03,000	1,28,000	6,86,000	15,04,000	3,12,000	..	3,12,000	1908-1909
1909-1910	10,80,000	..	53,000	3,00,000	13,04,000	5,25,000	2,03,000	1,87,000	7,50,000	10,06,000	6,11,000	..	6,11,000	1909-1910
1910-1911	10,50,000	..	54,000	2,00,000	11,35,000	5,40,000	2,03,000	2,84,000	75,000	11,02,000	6,44,000	..	6,44,000	1910-1911
1911-1912	10,80,000	..	55,000	..	11,65,000	5,60,000	2,03,000	3,93,000	80,000	12,11,000	5,89,000	48,000	48,000	1911-1912
1912-1913	11,00,000	..	58,000	..	11,87,000	5,65,000	2,03,000	3,85,000	80,000	12,13,000	5,63,000	80,000	80,000	1912-1913
1913-1914	11,30,000	..	57,000	..	12,08,000	5,75,000	2,03,000	3,77,000	80,000	12,15,000	5,66,000	1,44,000	1,44,000	1913-1914
1914-1915	11,50,000	..	58,000	..	12,29,000	5,85,000	2,03,000	1,77,000	80,000	12,35,000	7,50,000	1,76,000	1,76,000	1914-1915
1915-1916	11,70,000	..	59,000	..	12,50,000	5,95,000	2,03,000	1,77,000	80,000	12,55,000	9,75,000	2,04,000	2,04,000	1915-1916
1916-1917	11,90,000	..	60,000	..	12,71,000	6,05,000	2,03,000	1,77,000	80,000	12,81,000	1,91,000	2,32,000	2,32,000	1916-1917
1917-1918	12,10,000	..	61,000	..	12,92,000	6,15,000	2,03,000	1,77,000	80,000	13,01,000	1,91,000	2,32,000	2,32,000	1917-1918
1918-1919	12,30,000	..	62,000	..	13,13,000	6,25,000	2,03,000	1,77,000	80,000	13,21,000	1,91,000	2,32,000	2,32,000	1918-1919
1919-1920	12,60,000	..	63,000	..	13,34,000	6,35,000	2,03,000	1,77,000	80,000	13,41,000	1,91,000	2,32,000	2,32,000	1919-1920
1920-1921	12,70,000	27,000	66,000	..	13,92,000	6,35,000	2,03,000	1,77,000	80,000	13,72,000	1,91,000	2,32,000	2,32,000	1920-1921
1921-1922	12,90,000	30,000	96,000	..	14,16,000	6,45,000	2,03,000	1,77,000	80,000	13,96,000	1,91,000	2,32,000	2,32,000	1921-1922
1922-1923	18,00,000	32,000	99,000	..	14,29,000	6,50,000	2,03,000	1,77,000	80,000	14,09,000	1,91,000	2,32,000	2,32,000	1922-1923
1923-1924	18,20,000	36,000	98,000	..	14,53,000	6,60,000	2,03,000	1,77,000	80,000	14,33,000	1,91,000	2,32,000	2,32,000	1923-1924
1924-1925	18,30,000	37,000	99,000	..	14,66,000	6,65,000	2,03,000	1,77,000	80,000	14,57,000	1,91,000	2,32,000	2,32,000	1924-1925
1925-1926	18,40,000	38,000	99,000	..	14,81,000	6,75,000	2,03,000	1,77,000	80,000	15,06,000	1,91,000	2,32,000	2,32,000	1925-1926
1926-1927	13,60,000	40,000	1,01,000	..	15,05,000	6,80,000	2,03,000	1,77,000	80,000	15,10,000	1,91,000	2,32,000	2,32,000	1926-1927
1927-1928	13,60,000	42,000	1,03,000	..	15,20,000	6,85,000	2,03,000	1,77,000	80,000	15,25,000	1,91,000	2,32,000	2,32,000	1927-1928
1928-1929	13,70,000	45,000	1,05,000	..	15,44,000	6,95,000	2,03,000	1,77,000	80,000	15,54,000	1,91,000	2,32,000	2,32,000	1928-1929
1929-1930	13,90,000	47,000	1,07,000	..	15,65,000	7,00,000	2,03,000	1,77,000	80,000	15,75,000	1,91,000	2,32,000	2,32,000	1929-1930
1930-1931	14,00,000	50,000	1,09,000	..	15,85,000	7,05,000	2,03,000	1,77,000	80,000	15,95,000	1,91,000	2,32,000	2,32,000	1930-1931

MADRAS PORT TRUST

FORECAST DIAGRAM OF REVENUE RECEIPTS AND EXPENDITURE

UP TO 1929 - 30

VERTICAL SCALE RS. 2,00,000 = 1 INCH
" TONS 2,00,000 = 1 INCH



APPENDIX VI.

Forecast showing the probable financial position of the Madras Port Trust, up to the year 1929-30, on the assumption that Government makes a free grant of Rs. 20 lakhs and agrees to lend the Port Trust, at 4 per cent. interest, the remainder of the sum, Rs. 53 lakhs, necessary for constructing ship wharves and that it is decided to raise dues when requisite. The 53-lakh loan to be repaid in equated monthly payments of principal and interest in 47 years.

Year.	Incomings.					Outgoings.				State of Trust balances.			
	Gross revenue receipts. Curve A.	Additional Harbour dues on goods passing over quays. Curve FF.	Port fund contributions. Curve EE.	Tempo-rary loan. Rs.	Total Incomings. Rs.	Working expenses on account of column 2. Curve B.	Old loan repaid with interest. Rs.	Harbour extension loan and temporary loan, column 5, repaid with interest. Rs.	Revenue contribution to capital. Rs.	Total outgoings. Rs.	State of the Trust's balances in successive years, based on columns 2 to 11. Rs.	New 53 lakh loan interest and repayment. Rs.	Trust's balances, column 12, modified by column 13. Rs.
1	2	3	4	5	6	7	8	9	10	11	12	13	14
15	16												
1904-1905	8,45,000	..	..	..	8,65,000	4,83,000	2,73,000	..	1,20,000	8,66,000	8,66,000	..	8,66,000
1905-1906	9,48,000	..	20,000	..	9,68,000	3,76,000	2,08,000	2,000	2,76,000	8,57,000	8,94,000	..	8,94,000
1906-1907	10,82,000	..	..	..	10,82,000	5,82,000	2,08,000	33,000	7,76,000	15,74,000	10,05,000	..	10,05,000
1907-1908	10,80,000	..	70,000	..	10,80,000	5,14,000	2,03,000	78,000	6,05,000	14,00,000	4,83,000	..	4,83,000
1908-1909	10,80,000	..	53,000	..	10,80,000	5,07,000	2,03,000	1,98,000	6,86,000	15,04,000	4,83,000	..	4,83,000
1909-1910	10,80,000	..	54,000	..	10,80,000	5,25,000	2,03,000	1,87,000	8,00,000	16,06,000	6,11,000	..	6,11,000
1910-1911	10,80,000	..	55,000	..	10,80,000	5,40,000	2,03,000	2,84,000	76,000	11,02,000	6,44,000	..	6,44,000
1911-1912	10,80,000	..	56,000	..	10,80,000	5,50,000	2,03,000	3,83,000	66,000	12,13,000	6,89,000	..	6,89,000
1912-1913	11,00,000	..	57,000	..	11,00,000	5,65,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000
1913-1914	11,00,000	..	58,000	..	11,00,000	5,75,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000
1914-1915	11,00,000	..	59,000	..	11,00,000	5,85,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000
1915-1916	11,00,000	..	60,000	..	11,00,000	5,95,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000
1916-1917	11,00,000	..	61,000	..	11,00,000	6,05,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000
1917-1918	11,00,000	..	62,000	..	11,00,000	6,15,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000
1918-1919	11,00,000	..	63,000	..	11,00,000	6,25,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000
1919-1920	11,00,000	..	64,000	..	11,00,000	6,35,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000
1920-1921	11,00,000	..	65,000	..	11,00,000	6,45,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000
1921-1922	11,00,000	..	66,000	..	11,00,000	6,55,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000
1922-1923	11,00,000	..	67,000	..	11,00,000	6,65,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000
1923-1924	11,00,000	..	68,000	..	11,00,000	6,75,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000
1924-1925	11,00,000	..	69,000	..	11,00,000	6,85,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000
1925-1926	11,00,000	..	70,000	..	11,00,000	6,95,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000
1926-1927	11,00,000	..	71,000	..	11,00,000	7,05,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000
1927-1928	11,00,000	..	72,000	..	11,00,000	7,15,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000
1928-1929	11,00,000	..	73,000	..	11,00,000	7,25,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000
1929-1930	11,00,000	..	74,000	..	11,00,000	7,35,000	2,03,000	3,82,000	60,000	12,13,000	6,89,000	..	6,89,000

SECTION
SHOWING 40 WELLS OF NORTH QUAY

FIG 1

SECTION

SHOWING 7 WELLS AT EAST END
OF JETTY

SECTION
SHOWING 40 WELLS OF SOUTH QUAY

PLATE II

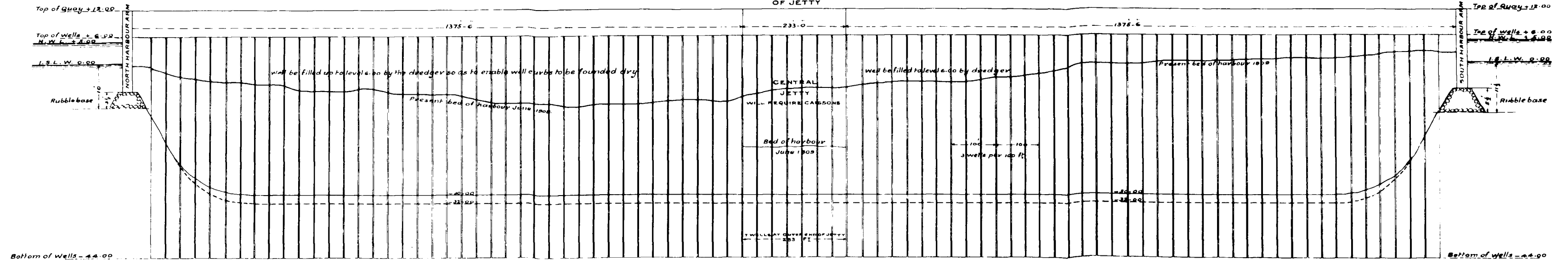
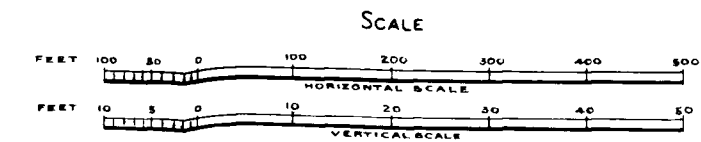


FIG 2
CENTRAL JETTY

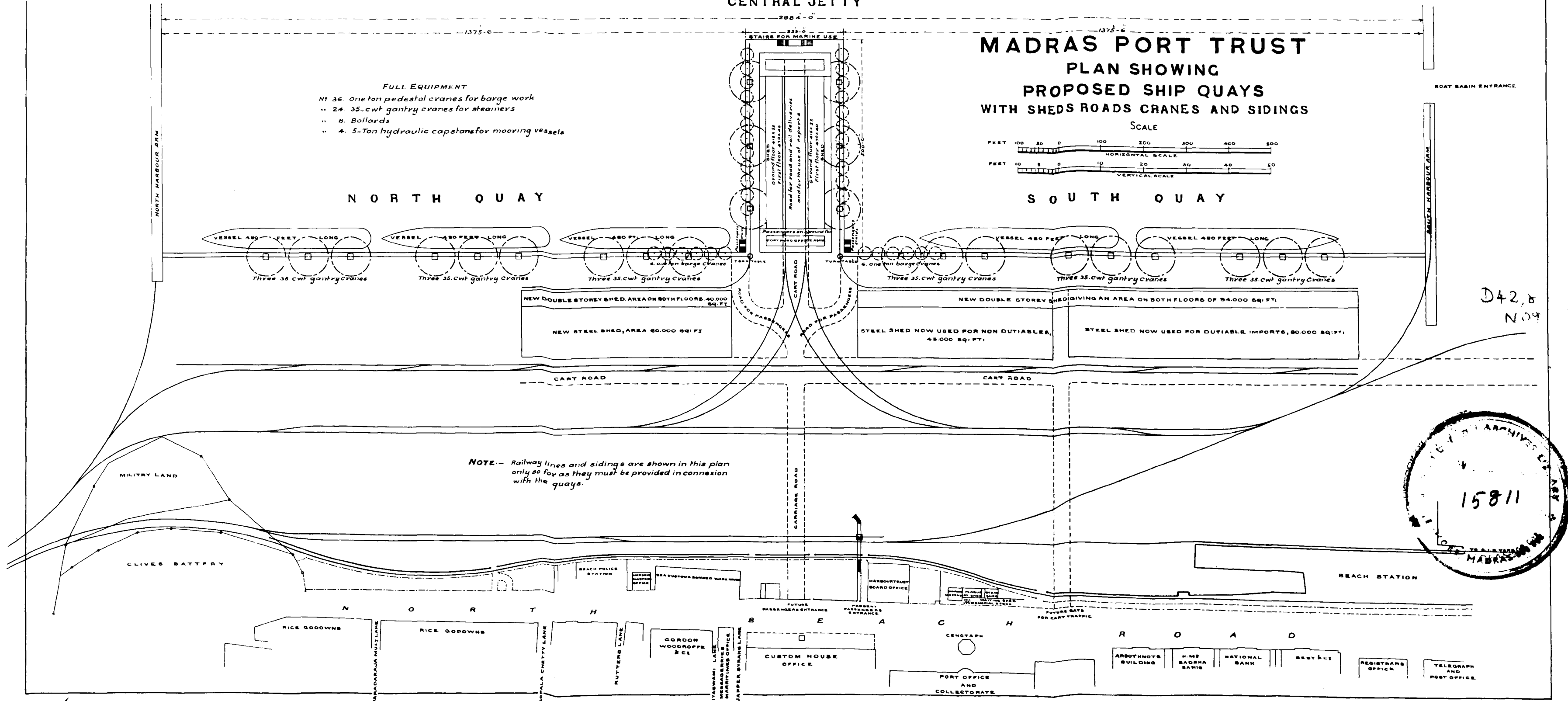
MADRAS PORT TRUST
PLAN SHOWING
PROPOSED SHIP QUAYS
WITH SHEDS ROADS CRANES AND SIDINGS



- FULL EQUIPMENT
- " 36. One ton pedestal cranes for barge work
 - " 24. 35-cwt gantry cranes for steamers
 - " 8. Bollards
 - " 4. 5-Ton hydraulic capstans for mooring vessels

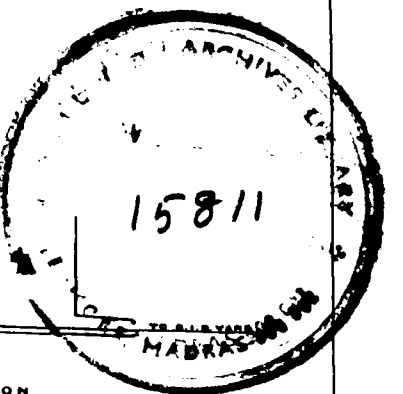
NORTH QUAY

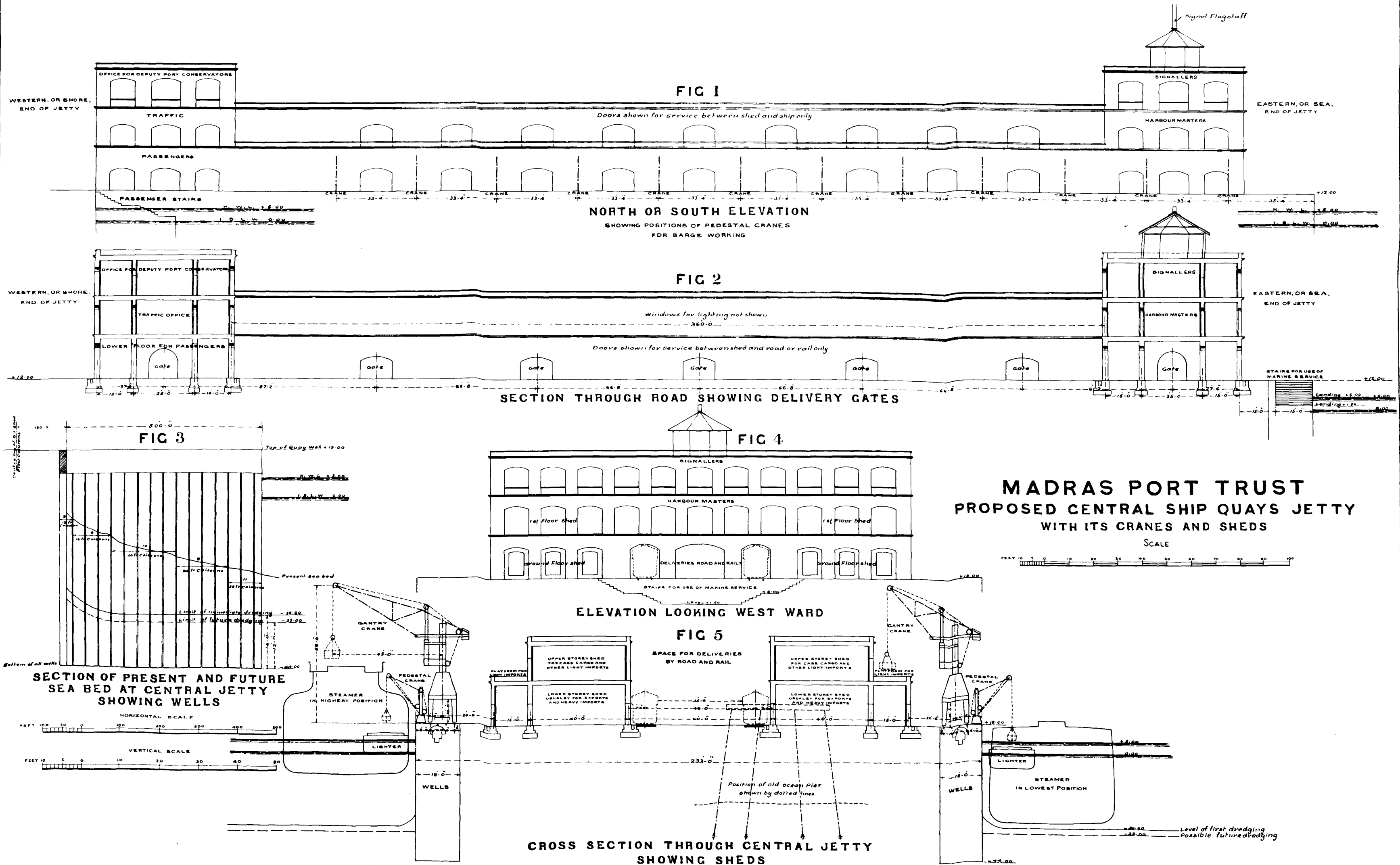
SOUTH QUAY



NOTE.— Railway lines and sidings are shown in this plan only so far as they must be provided in connexion with the quays.

D42,8
N04





MADRAS PORT TRUST
SECTION ON NORTH AND SOUTH SHIP QUAY
SHOWING TRACKS, ROADS AND SHEDS

SCALE



SECTION OF QUAY

FIG 1

SECTION OF SHEDDING

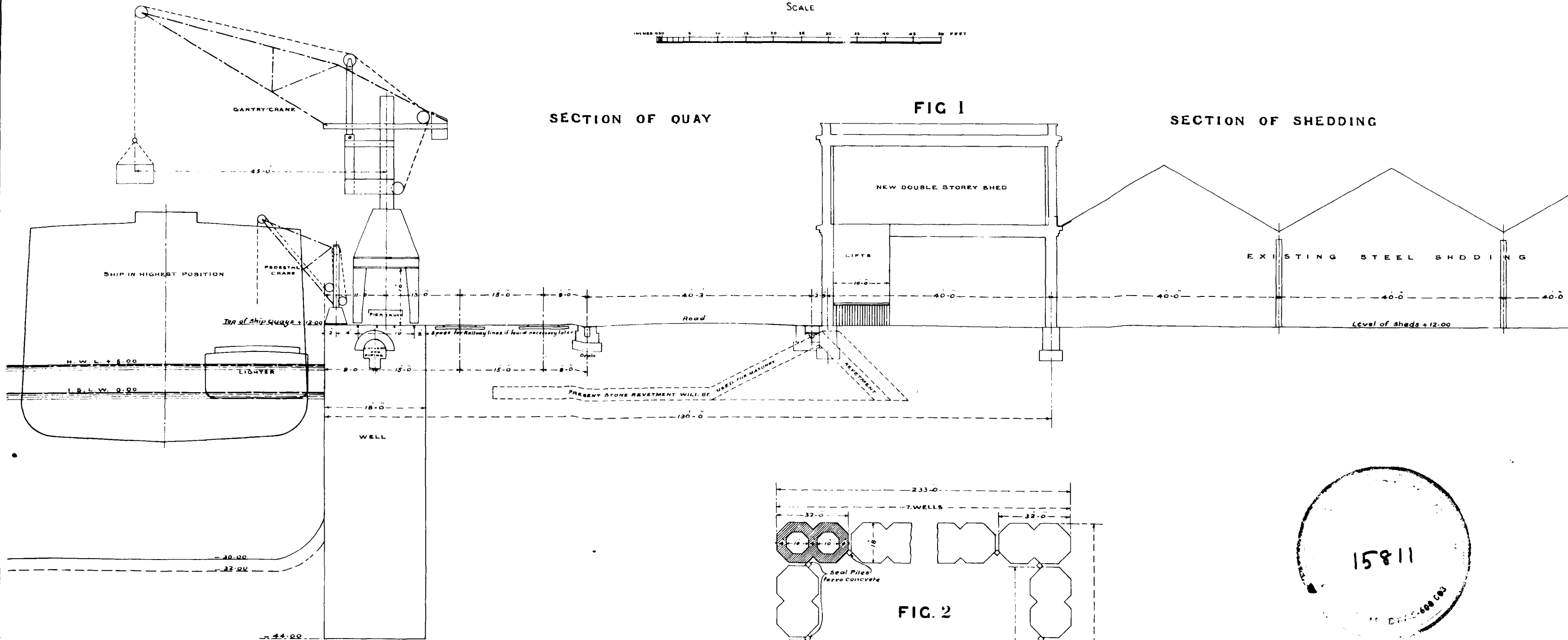


FIG. 2

CENTRAL JETTY



PLAN SHOWING ARRANGEMENT OF WELLS

SCALE

