

wall, form an apron *in situ* of 6 to 1 Portland cement concrete, as shown by dotted lines on Fig. 3, and explained in the note referring thereto. It is highly important that this apron should be provided if the bottom, when bared, previous to the putting-in of the lower courses, appears to be of a character which may be subsequently disturbed by the sea.

Upon the completion of two courses in height throughout the extent of the root, the space between the walls is to be filled in solid with a hearting of rubble-stone, and, simultaneously with the execution of the superincumbent courses, the rubble hearting is to be again deposited, layer by layer, until it reaches the formation-level of the concrete protective skin, where it must be trimmed off to receive the latter, which is to be 20ft. in width from the back of the sea-wall, commencing 30ft. seaward of the starting-point, and terminating at the junction with the pitched surface 230ft. therefrom. This protective skin, or paving, to consist of 8 to 1 Portland cement concrete, run in solid amongst clean rubble-stone, so as to form a skin of at least 15in. thick for the outer portion of the paving, decreasing gradually to 9in. in thickness at the commencement, 30ft. from the starting-point. Seaward of the concrete pavement, and commencing 230ft. from the starting-point, the surface of the rubble between the sea and the harbour walls of the root to be coated with 8 to 1 Portland cement concrete, deposited as described for the concrete paving of the inner portion, finishing at the level shown on Fig. 3, drawing No. 2, and paved with hammer-dressed stone to adapt it for cart traffic, resting upon the bed of concrete and run in solid with Portland cement grout, broomed into the joints. Previous to the laying of the pitching, the longitudinal sleepers of matai wood (see Fig. 8, drawing No. 3) are to be bedded into the concrete to receive the rails for the Hercules, or portable overhanging setting-machine, and for the block road to feed the same. These sleepers throughout to be 12in. wide at the top, and 6in. thick, sawn on all four sides, and tapered $\frac{3}{4}$ in. on each, so as to leave the concrete freely for renewals, and the upper arrises chamfered to receive the pitching-blocks, the sleepers to be in such lengths as can be conveniently obtained in the colony.

Breakwater Pier

The pier proper will commence at the root abutment, at 335ft. from the starting-point, and proceed therefrom for a length of 470ft., in accordance with Fig. 1, drawing No. 3. From this latter point seaward the section will be as shown on Fig. 1, drawing No. 4.

Bagwork.—The substructure of the pier, from the bottom to the level of 1ft. 9in. above low-water spring-tide, for that portion of the work shown on Fig. 1, drawing No. 3, over the length just described, and also the foundations where the section of the pier is to be of the character shown on Fig. 1 drawing No. 4, are to consist of concrete, composed of one part of Portland cement to six of broken stone, shingle, and sand, arranged in proper proportions to form a compact mass free from vacuities, deposited in bags of jute sacking, made from material weighing 20oz. per lineal yard for a width of 27in., sewn with double flax, 10lb. tarred twine, with sailmakers double seams throughout. The bags are to be deposited in wrought-iron boxes, of which two will be required of the character shown in drawing No. 7 the bags being made somewhat larger than the box, so as to obviate as far as practicable their bursting on being discharged therefrom. The maximum weight of the bags of concrete when the box is filled to the depth of 3ft. 6in. will be 14 tons. Compensation layers will, however, be introduced where required to make up inequalities, by partially filling the box, and also by the use of 2-bushel and 4-bushel bags. The top or flap of the jute sacking to be in one piece with the back, and to be securely sewn to the sides along the top edge after the concrete has been filled into the box. The bag-boxes would be lowered into position from the jib of the portable setting-machine referred to in item 1 of the foregoing list of special plant.

The information now available as to the nature of the bottom along the line of the pier is not sufficient to enable a determination to be arrived at as to the necessity or otherwise for excavating the surface of the sand with a view to the bagwork being carried down to the boulder or other compact foundation therefore, prior to the commencement of the bag-laying, careful borings or probings must be made along the site, so as to determine at what depth the solid bottom may be reached. Upon the receipt of these particulars as to the precise character of the bottom, the Consulting Engineer will be in a position to determine the expediency or otherwise of excavating a portion of the surface-sand, and in what manner this can best be done, with a view to the lowering of the foundations below the present sea-bed, in the manner shown on Fig. 1, or possibly to a greater extent should the data then available show this to be necessary.

Upon the bag substructure, Fig. 1, drawing No. 3, being raised to the surface, the work would be levelled off by the deposit of smaller bags, and the high places in the large bags scapped down, so as to form a level bed to receive the superincumbent blocks. Along that portion of the pier where the foundations are to be levelled under water, in the manner shown on Fig. 1, drawing No. 4, the bags, which will be placed in position with a view to being in themselves approximately level, will be coated with a layer of broken stone, which latter would be formed to an even and true bed to receive the blocks, sealing or long bags of concrete being placed in position previous to the lower course of blocks being laid thereon, as shown.

Upon the completion of that portion of the pier shown on Fig. 1, drawing No. 3, it will in all probability be desirable to employ in connection with the diving operations necessary for the preparation of the bed to receive the bags for the work shown on Fig. 1, drawing No. 4, and also for the deposit of these bags, and for the levelling skin of rubble, a barge with suitable overhead frame and gearing, having a central well through which the bag-box could be raised and lowered, the said barge being adapted for containing a sufficient quantity of concrete materials for a day's consumption.

For the reasons above referred to, as to the absence of precise data with reference to the character of the bottom, it cannot now be determined whether or not it will be requisite to protect the seaward toe of the foundations with an apron in the manner shown on Fig. 1, drawing No. 3, and Fig. 1, drawing No. 4, but, should the examination along the site of the pier referred to above