

few feet above low water. Piers projected across shingle or sandy foreshores constitute in effect groynes arresting the littoral movement of drift. As such, unless designed with skill, they are apt to set up irregular shoaling and bars outside the harbour mouth. The contours of the bars which form in advance of them are in plan mostly sickle- or horseshoe-shaped.

The relative lengths and overlapping of entrance piers are matters which have frequently made or marred a harbour design. Thus at Durban harbour, South Africa,¹ the governing authority overruled the judgment of the engineers as to the design of the entrance piers, and, for a period of nearly sixty years, the harbour was of inadequate depth and one of the most uneasy on the South African littoral. This was mainly by reason of the fact that the south pier, as built and extended, persistently overlapped the north pier. Ultimately piers of equal length were adopted. The economy of the drift was thus changed, and the harbour now shows progressive deepening and commercial value.

In some instances a leeward pier has been so laid out as to act as a sand trap, thus threatening with extinction the harbour it was built to serve.

The ratio between the necessary tidal volume of water entering a harbour and the sectional area below low water of its entrance, in order to attain and maintain a given working depth of water, is variable. It appears that at Durban 1400 cubic yards of tidal volume per square foot of section of low-water channel sufficed to maintain or slightly increase depths of 33 feet and upwards, whereas, at the entrance channel of Cork harbour, 1050 cubic yards per foot of section secured complete scouring effect up to depths of 60 feet.

Flushing reservoirs have been devised in many localities, but their effects are apt to be capricious and irregular. The sudden release of a large volume of effluent water under a considerable head will dig deep pits in the vicinity of the reservoir and redeposit the scoured material in ridges or shoals, unless

¹ "Durban Harbour, South Africa" (C. W. Methven), *Proc. Inst. C. E.*, Vol. CXCI, pp. 1-122.