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Current Deflecting Wall: A Promising Structure for Minimising Siltation in Semi-Enclosed Docks

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Abstract : Many estuarine harbours in the world are facing the problem of siltation in docks, channel entrances, etc. The harbours in India are not an exception and require maintenance dredging to achieve navigable depths for keeping them operable. Hence, dredging is inevitable and is a costly affair. The heavy siltation in docks in well mixed tide dominated estuaries is mainly due to settlement of cohesive sediments in suspension. As such there is a need to have a permanent solution for minimising the siltation in such docks to alter the hydrodynamic flow field responsible for siltation by constructing structures outside the dock. One of such docks on the west coast of India, wherein siltation of about 2.5-3 m/annum prevails, was considered to understand the hydrodynamic flow field responsible for siltation. The dock is situated in such a region where macro type of semi-diurnal tide (range of about 5m) prevails. In order to change the flow field responsible for siltation inside the dock, suitability of Current Deflecting Wall (CDW) outside the dock was studied, which will minimise the sediment exchange rate and siltation in the dock. The well calibrated physical tidal model was used to understand the flow field during various phases of tide for the existing dock in Mumbai harbour. At the harbour entrance where the tidal flux exchanges in/out of the dock, measurements on water level and current were made to estimate the sediment transport capacity. The distorted scaled model (1:400 (H) & 1:80 (V)) of Mumbai area was used to study the tidal flow phenomenon, wherein tides are generated by automatic tide generator. Hydraulic model studies carried out under the existing condition (without CDW) reveal that, during initial hours of flood tide, flow hugs the docks breakwater and part of flow which enters the dock forms number of eddies of varying sizes inside the basin, while remaining part of flow bypasses the entrance of dock. During ebb, flow direction reverses, and part of the flow re-enters the dock from outside and creates eddies at its entrance. These eddies do not allow water/sediment-mass to come out and result in settlement of sediments in dock both due to eddies and more retention of sediment. At latter hours, current strength outside the dock entrance reduces and allows the water-mass of dock to come out. In order to improve flow field inside the dockyard, two CDWs of length 300 m and 40 m were proposed outside the dock breakwater and inline to Pier-wall at dock entrance. Model studies reveal that, during flood, major flow gets deflected away from the entrance and no eddies are formed inside the dock, while during ebb flow does not re-enter the dock, and sediment flux immediately starts emptying it during initial hours of ebb. This reduces not only the entry of sediment in dock by about 40% but also the deposition by about 42% due to less retention. Thus, CDW is a promising solution to significantly reduce siltation in dock.

Keywords : current deflecting wall, eddies, hydraulic model, macro tide, siltation
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