4.3 HARBOUR LAYOUT AND TERMINAL FACILITIES

Estimation of littoral drift and direction of net drift are needed for design of harbour projects. Different methods are used to study shoreline changes in the coastal area. Among them, mathematical modelling is considered as an effective technique. The current study addresses this issue through the use of mathematical models viz. spectral wave model to derive nearshore wave climate, Boussinesq wave model for evolving the harbour layout to provide adequate wave tranquillity in the harbour basin and one line model for prediction of shoreline changes in the adjacent shoreline of the project.

In the present study, the mathematical models were applied for design of a layout for fishing harbour, on the West Coast of India in Kerala State. Different alternatives of the harbour layout were tested in order to reduce siltation in the harbour and also to achieve the desired tranquillity in the harbour basin. In the first alternative, the southern breakwater was extended by 340 m. However it was observed that after two to three years, the shoreline will advance and the drift will start entering the harbour basin. Therefore, in the second alternative, the mouth of the harbour was further taken into deeper water to minimize the drift entering in the harbour. With this alternative the wave tranquility studies showed that the layout is adequate to provide desired tranquility in the harbour basin and the wave heights will remain within 0.3 m almost round the year. Thus, mathematical modelling technique was used to evolve a harbour layout that satisfies the tranquillity criteria and also ensures minimum siltation in the harbour basin.

Introduction

Fisheries sector is considered as one of the most important productive and developing sectors of the Kerala state. In order to promote fishing sector Kerala government is building fishing harbours across Kerala coast. One such fishing harbour with two breakwaters, north breakwater of 145 m length and south breakwater of 476 m length was constructed at Thottappally. The location is fully exposed to the high waves of upto 2.5 m height from Arabian Sea and also to the effects of littoral drift. Presently, major siltation in the harbour and subsequent advancement of the shoreline on southern side of south breakwater and erosion on northern side of north breakwater has been observed since the construction of the two breakwaters.

Central Water and Power Research Station (CWPRS) suggested modifications to the existing harbour layout to minimize the problem of siltation in the harbour and provide adequate wave tranquillity. This paper presents Mathematical model studies carried out to optimize the harbour layout to provide desired tranquillity in the harbour and also to reduce siltation in the harbour.

Methodology

The offshore wave data reported by India Meteorological Department as observed from ships plying in deep waters off Thottappally were transformed by MIKE 21 (SW) Spectral Wave model to get the near-shore wave climate at the fishing harbour in the absence of measured near-shore wave data. MIKE21- (BW) Boussinesq Wave was used for assessment of near-shore wave field and wave penetration in the fishing harbour. Estimation of littoral drift distribution and simulation of shoreline changes were carried out using LITPACK model. These mathematical models are developed by Danish Hydraulic Institute , Denmark **ite Conditions**

The fishing harbour is situated at 9°19'8.64"N latitude and 76°22'47.21"E longitude. The near-shore bathymetry at the site is having mild slope and the coastline orientation is 1550 N. Mean tidal level is 0.6 m. observed shoreline changes from October 2005 to February 2013 were considered for the study. The grain size (D50) varied from 0.22 mm to 0.09 mm.

Littoral drift between Fort Cochin and Anthakaranazhi is 7X106 m3 towards south as estimated by Pravin D Kunte (2001). Longshore sediment transport rates for the Kerala Coast were estimated by V. Sanil Kumar (2006). The annual net transport of 16,929 m3 towards north was estimated at Alleppey which is about 25 km towards North of Thottappally. The annual net transport of 383,784 m3 towards south was estimated at

Kollam which is about 50 km towards South of Thottappally. From shoreline changes occurring in the vicinity of the breakwaters and also the satellite imageries from Google, it is seen that net drift is towards north. The Offshore wave climate during the entire year indicates that the predominant wave directions in deep water are from SSW to West with the maximum wave heights of the order of 4.5 m. These deep water wave data were transformed by MIKE 21- SW model to get the nearshore wave climate in 8m depth at the fishing harbour.

Estimation of littoral drift distribution and simulation of shoreline changes

LITDRIFT module of LITPACK software was used to estimate annual littoral drift rates and its distribution on the profile normal to the shoreline. The LITDRIFT module simulates the cross-shore distribution of wave height, setup and longshore current for an arbitrary coastal profile. The longshore and cross-shore momentum balance equation is solved to give the cross-shore distribution of longshore current and setup. Wave decay due to breaking is modelled. LITDRIFT calculates the net/gross littoral transport over a specific design period. Important factors, such as linking of the water level and the beach profile to the incident sea state, are included. The bed profile near the harbour was used for drift computation. This profile covers a distance of 2.4 km extending up to about -8m depth contour (with respect to Chart Datum). The profile was descretized with grid size of 10 m. The model was calibrated for observed shoreline changes. The model was run for annual nearshore wave climate. Annual, northward and southward transport rates were computed. The northward drift is plotted as positive while southward drift is plotted as negative.

In order to assess the impact of the breakwaters on the coastline, LITLINE module of LITPACK software was used. The length of the shoreline considered for the studies is 1.2 km, extending about 500 m towards north of the breakwater and about 500 m towards south of the breakwater. It is divided into 236 grid points of grid size 5 m. The harbour layout proposed by Harbour Engineering Division (HED), Kerala, was considered for the shoreline evolution. The harbour layout consists of Northern breakwater of 250 m length and southern breakwater of 816 m (476+340) length. LITLINE is a one dimensional model. Therefore, projected lengths of the breakwaters were considered in the model setup. For the proposed layout, projected lengths of 250 m and 370 m of the Northern and Southern breakwater were considered respectively.

While the modified layout suggested by CWPRS, consists of southern breakwater of 896 m (476+420) and Northern breakwater of 436 m length. For the modified layout, projected lengths of 388 m and 460 m of the Northern and Southern breakwater were considered respectively. The model was run for 2, 4 and 6 years with the proposed breakwaters and modified breakwaters.

Marine Terminals

A terminal is a place where loading and unloading of people or goods takes place like for e.g. a bus terminal or a train terminal. In simple terms it can be said that marine terminals are stops or stations for ships and boats.

However, it has to be noted that a marine terminal is not a distinct station for the ships. Marine terminals just form a part of the port where goods and cargo can be loaded into a ship and unloaded in case a ship comes to the port. Marine terminals are very popular and form an important necessity when it comes to the cargo aspect of ships.

The port or harbour is a very busy place. There are not just passengers arriving but there are also people waiting to aboard a ship. In addition to so many people, there is also the hauling and offloading of cargo that needs to be done since cargo ships also form a major component in ports.

If proper care is not taken to load the cargo in the proper ship or offload the goods correctly in the right manner, then it could lead to a lot of loss. This loss would not only be in terms of finance but also in terms of important and necessary goods and commodities, to both the businessmen as well as the clients.

This is the main reason why marine terminals are kept separate from the rest of the port or harbour. This keeping aside of a separate area ensures that the loading and offloading process takes place continuously, and in the most perfect manner. It has to be noted that marine terminals are also known as docks (used for bigger ships) and wharfs (when ships of smaller sizes are hauled with cargo).

Another important presence in such marine terminals is of the people, who are responsible for the smooth functioning of the marine terminal. The professionals who help with the entire goods hauling and unloading process work round-the-clock and tirelessly to make sure that there are no errors whatsoever. They are alert and responsible professionals which make it easier for the companies and clients to trust such marine terminals with their goods and cargo.

Marine terminals are also an important necessity when it comes to oil rigs and oil drillings. In the deep oceanic and high sea areas where oil drilling and oil rigs form a crucial part, the crude oil containers are hauled and emptied in marine terminals that are located in the high seas. This ensures that a regular supply of crude oil and gas is maintained to the inshore areas as and when required. This continuous supply also helps to avoid any chances of oil spills and accidents in case any oil tanker collapses due to excess weight.

Business activities carried over sea-routes are a very old custom. But even as they were popular and necessary in the olden days, the amount of loss to the cargo was also huge because of lack of regulation. In today's times, with the benefits and assistance provided by marine terminals, the prospect of loss has been reduced drastically. For this reason alone, marine terminals and the people who work in such terminals deserve to be appreciated and admired greatly.