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Design of Fishing Harbour Layout in High Littoral Drift Zone

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Abstract

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.

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Keywords: Fishing Harbour; Littoral Drift; Wave Transformation; Wave Tranquility; Siltation

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1. 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.

2. 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

3. Site Conditions

The fishing harbour is situated at 9°19'8.64"N latitude and 76°22'47.21"E longitude (Fig 1). The near-shore bathymetry at the site is having mild slope and the coastline orientation is 155^0N. Mean tidal level is 0.6 m. observed shoreline changes from October 2005 to February 2013 were considered for the study. The grain size (D_{50}) varied from 0.22 mm to 0.09 mm.

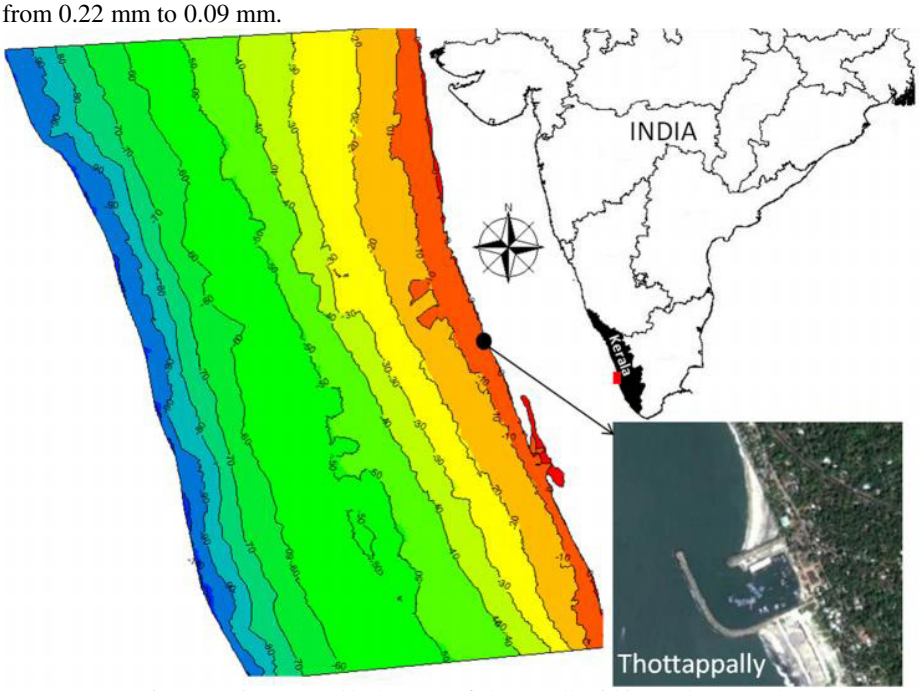

Fig 1. Location Map and bathymetry of Thottappally Fishing Harbour, Kerala