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2Diamentional Model Studies For Hydrodynamics At Tidal Inlet Using Mike Zero

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Abstract

The project concerns itself with the village of Satpati in Phalghar district of Maharashtra. Fishery being the main occupation of the village contributes profoundly to the Indian economy via import and export business. This project {In association with CWPRS, Pune} works towards tackling the problem of excess sedimentation accumulated at coastline of Satpati, which has led to flood like situation in the region. Also, fishermen have to wait for high tides which provides a window of 6-8 hours only to carry out the day to day activities. Here in, to find appropriate solution for removal of siltation 2D model studies are carried out in which onsite conditions are replicated using Mike software. The project works on preparing bathymetry using the Mike Zero software which defines the different depths of water in the region. In order to achieve maximum accuracy a region of 30km for larger grid and 3km for smaller grid of concerned area is mapped out. Using MIKE ZERO software,Bathymetry for the region was developed and calibrated and used to assess the changes likely to occur in hydrodynamics and siltation pattern.Experiments on the obtained flow field can be further carried out by CWPRS, Pune.

Keywords— Mathematical model, creek, sedimentation, hydrodynamics, coastal area

I. INTRODUCTION

Proposed site of Satpati, has geographical co-ordinates 19°43' N and 72°42' E is located about 100KM north of Mumbai and around 50KM south of Dahanu Maharashtra.Satpati is one of the biggest fishing villages on western coast of India, in Palghar, Maharashtra. The main industry is fishing, with large exports abroad.Due to excess siltation at the tidal inlet at Satpati, the velocity of water decreases therefore the fishermen have to wait for the high tides for the purpose of loading and unloading.The blockages due to excess siltation obstruct free water flow which creates flood like situation at coast line of Satpati.

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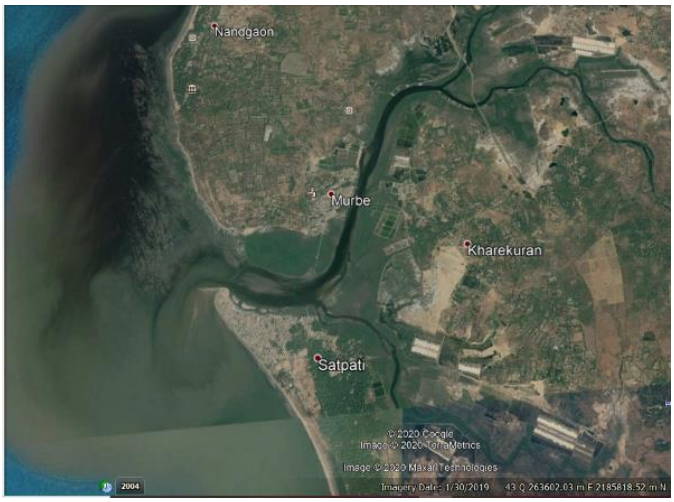

Fig 1. Tidal inlet at Satpati village (source - google earth)

Coastal Engineering-

Coastal engineering is defined as the application of the physical and the engineering sciences to the planning, design, and construction of works to modify or control the interaction of the air, sea, and land in the coastal zone for the benefit of mankind and for enhancement of natural shoreline resources.

Coastal Processes

As coastal engineering is the application of the physical and the engineering sciences to the planning, design, and construction of works to modify or control the interaction of the air, sea, and land in the coastal zone for the benefit of mankind and for enhancement of natural shoreline resources , coastal processes involved are as follows:

A. Hydrodynamics

Hydrodynamics is simply the study of liquids in motion. It is a branch of physics that deals with motion of fluids , forces acting on solid bodies immersed in fluids and also the motions relative to these immersed bodies. Coastal hydrodynamics concerns with protection from wave action, tidal flows, extra storm surges , etc. The hydrodynamic processes of waves generating wave setup and longshore currents results in transportation of sediments (e.g. sand) is called as littoral transport process. Therefore the link between hydrodynamic forcing and morphological response of the beach is realised through the transport of sediments.In order to stimulate the main phenomenon in coastal region , modelling (physical, chemical, composite) is employed to analyse the coastal hydrodynamic processes.

B. Waves

When wind blows over water, it exerts a drag on water surface, and water by virtue of its fluidity gets disturbed, giving rise to waves. These waves formed due to wind blowing over an area of fluid surface are called as surface waves .

The formation of waves is mainly due to 2 basic factors:

1. The interaction between wind and water.
2. The interaction between water and land.

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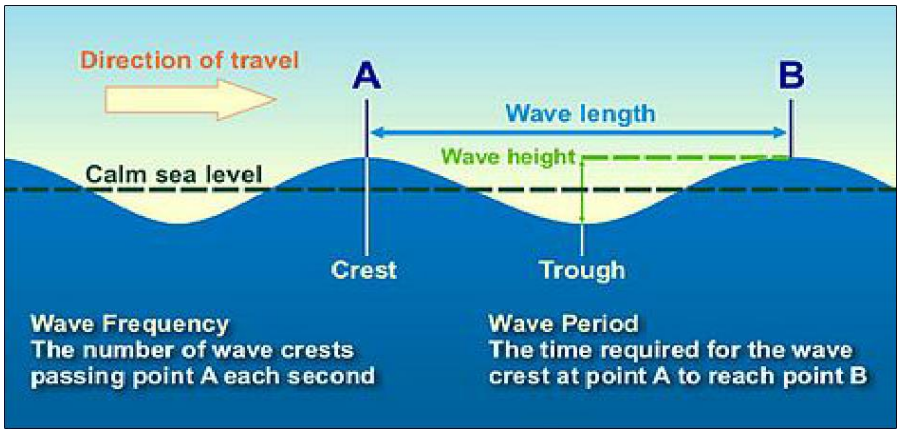

Fig. 2: Wave formation (Source –google images)

A gentle wind causes only ripples in the water but the stronger the wind becomes the more it pushes against the water.A very hard wind blowing for longer duration leads to formation of large waves.

The different types of waves are:

Deep seawaves, shallow water waves, translator waves, ripples or capillarywaves.

C. Tides

Tides are the rise and fall of the sea level caused by the combined effects of the gravitational forces exerted by the moon and the sun, and the rotation of the earth.

High and low tides are caused by the moon as the moon's gravitational pull generates force called as the tidal force. The tidal force causes earth and its waters to bulge out on the side closest to the moon and the side farthest from the moon.

These bulges of water closest to the moon are called high tides , whereas the bulges farthest from the moon are called as low tides.

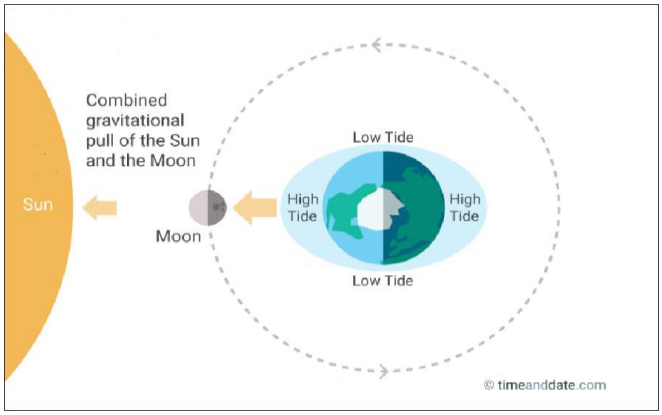

Fig. 3: Formation of High and low tides (Source –google images)

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D. Sediment transport

Sediment transport is simply the movement of solid particles due to forces acting on it. The forces acting maybe gravity and/or the fluids in which the sediment is present (or entering). Sediment transport also occurs due to wind , which leads to formation of ripples and sand dunes.

The flowing water in natural systems transports sediments , this process is called as fluvial process. Another type of sediment transport is due to granular flow at steep mountains and valleys which results in movementof large masses of material in debris flow.

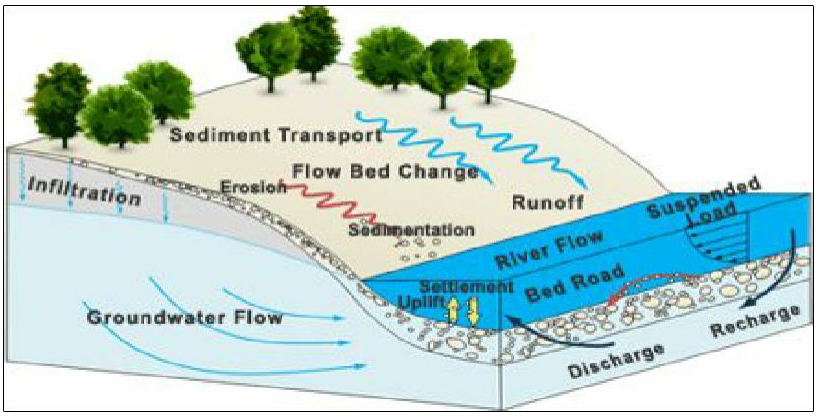

Fig. 4: Sediment transport in coastal environment (Source – google images)

In the coastal environment , sediment transport takes place due to motion of waves and currents. The coastal sediment transport results in formation of coastal landforms like beaches , barrier lands, capes , etc.
In coastal engineering, the knowledge of sediment transport is used to determine the erosion or deposition in the area. Also, it's magnitude and the time and distance over which it will occur.

Two Dimensional model studies using Mike21 software

Two dimensional model studies deal with the flow of water both longitudinally and laterally. Some of the widely used 2D model softwares are HEC-RAS 2D , LISFLOOD-FP and FLO-2D.
MIKE 21 software is a modelling system for 2D- free surface flow. It can also be used for waves , sediment transport , etc. The software can be used for simulating water level variations in response to the force functions occurring in lakes, estuaries and other coastal regions. It was developed by Danish Hydraulic Institute (DHI), Denmark. It is commercially available and accepted worldwide.
The Mathematical model studies to be undertaken for removal of siltation.

II. BATHYMETRY

Bathymetry is the study of underwater depth of lake or ocean floors. In other words, bathymetry is the underwater equivalent to hypsometry or topography. Originally, bathymetry involved the measurement of ocean depth through depth sounding. Satellites are also used to measure bathymetry. Satellite radar maps deep-sea topography by detecting the subtle variations in sea level caused by the gravitational pull of undersea mountains, ridges, and other masses. Occupations or careers related to

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bathymetry include the study of oceans and rocks and minerals on the ocean floor, and the study of underwater earthquakes or volcanoes.

Bathymetry is the information that describes the topography of the seabed, as depth from the sea surface to the seafloor. It is an essential component in understanding the dynamics of the marine environment. Safe ocean navigation relies on accurate bathymetry data, which are also essential for planning marine installations and infrastructure such as wind turbines, coastal defences, oil platforms and pipelines. Bathymetry forms the foundation of any comprehensive marine dataset; without it, the picture is incomplete.

III. PROCEDURE

Bathymetry is generated by extracting land data and water data for the Satpati location. The details of above mentioned data were obtained from Mike-21 C-MAP. It is data storage for the modeling techniques.

The extracted data is then incorporated in bathymetry file along with the rectified images. These altogether are then used to create accurate land and water boundaries of the location. After the incorporation of C-MAP data and image are used, triangular mesh is generated within the area of interest, which later contributes to the generation of relative bathymetry that shows the depth of water level in sea at every particular triangle node.

IV. RESULTS

- Bathymetry is the study of underwater depth of lake or ocean floors.
- Different colours in a bathymetry represents different depth of water level present at that place.
- Positive values denotes land area whereas negative value denotes the depth of water.

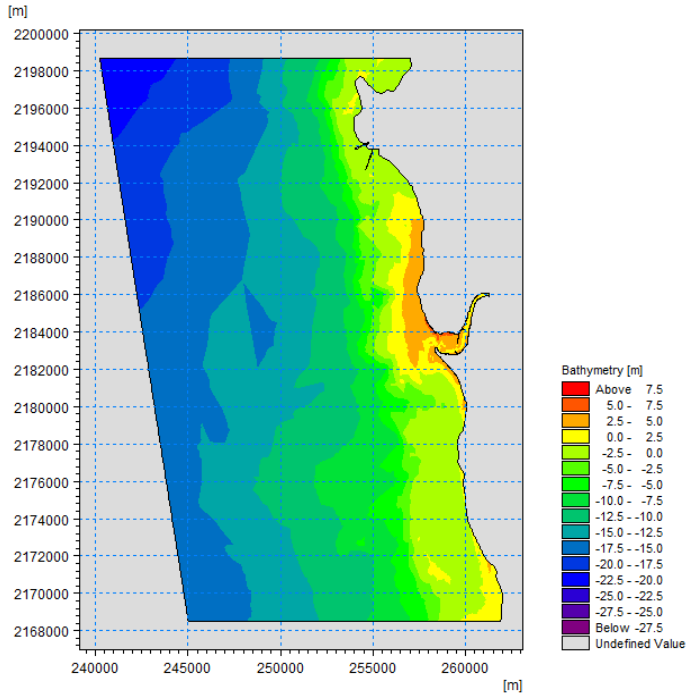

Fig. 5:Batnymetry for 30km area

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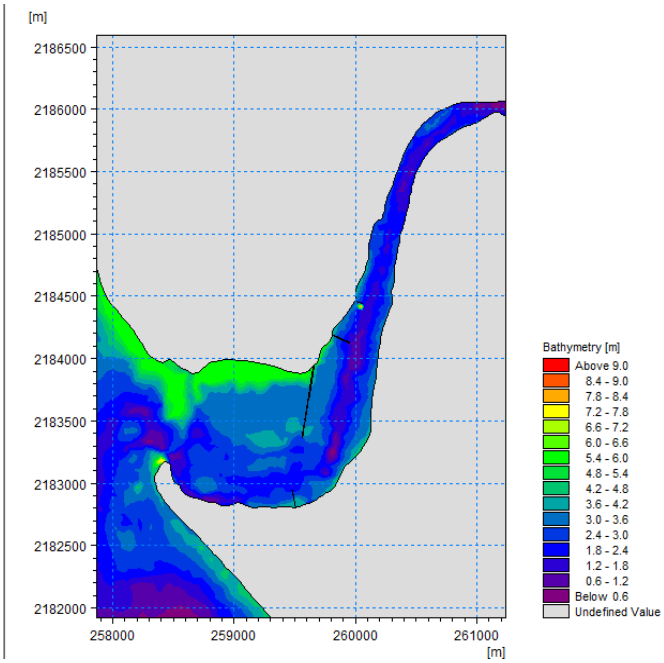

Fig. 6:Batnymetry for Satpati creek

V. BRIEF OUTCOMES OF THE PROJECT

Bathymetry for tidal inlet using latitude and longitude of model area, land point from sea map software and different water levels.

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