SOME ASPECTS OF COASTAL PROTECTION

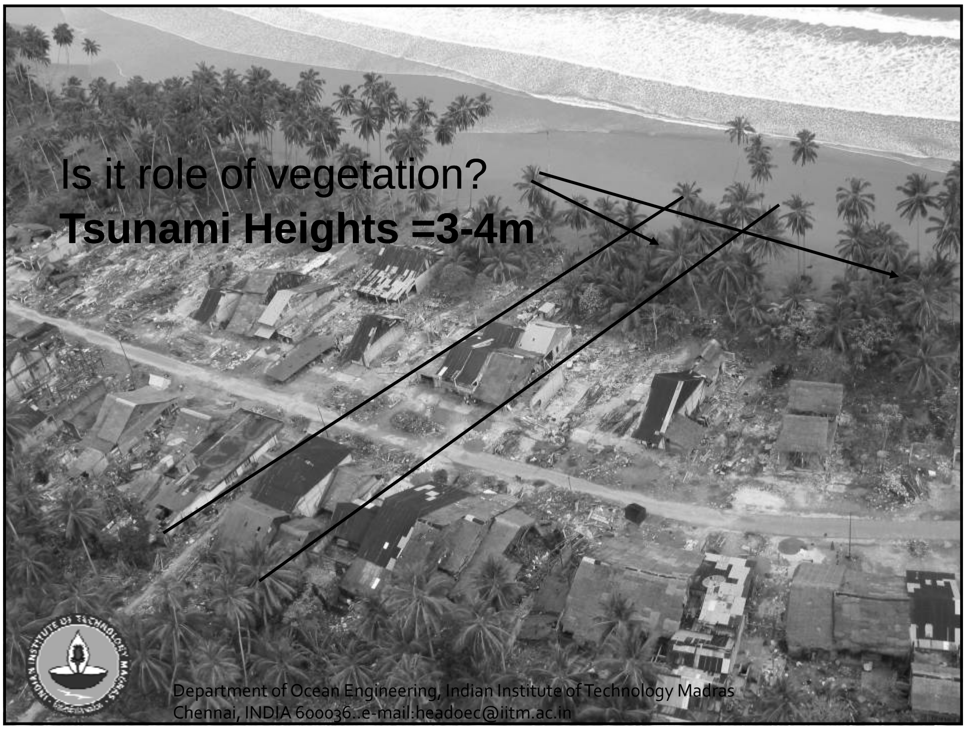
12th CPDAC meeting 3 Mar 2011 in Bhubaneshwar

By
Prof. V. Sundar
Department of Ocean Engineering
Indian Institute of Technology Madras
Chennai, INDIA

EXPERIMENTAL STUDIES

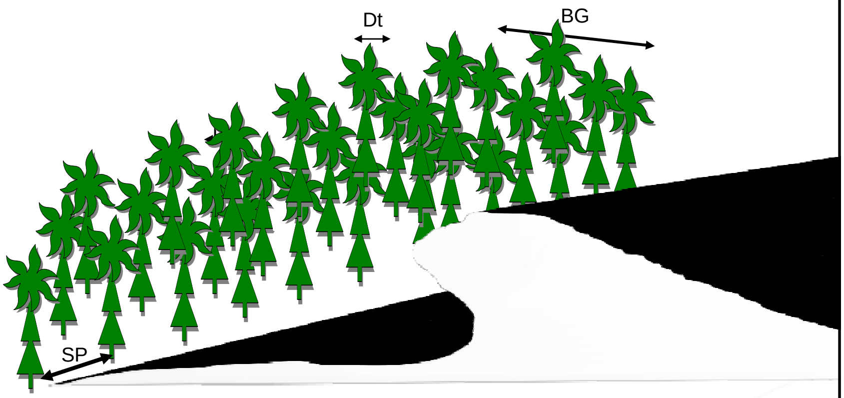
Interaction of Tsunami with vegetation

Department of Ocean Engineering,
Indian Institute of Technology Madras, Chennai, INDIA 600036,
e-mail: vsundar@iitm.ac.in



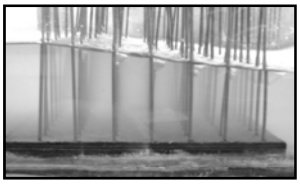
DESIGN QUESTIONS

Greenbelt Parameters



Department of Ocean Engineering,
Indian Institute of Technology Madras, Chennai, INDIA 600036,
e-mail: vsundar@iitm.ac.in

EXPERIMENTAL INVESTIGATIONS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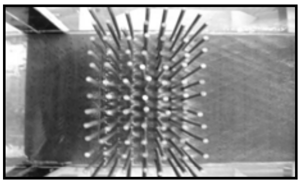
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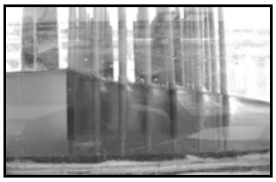
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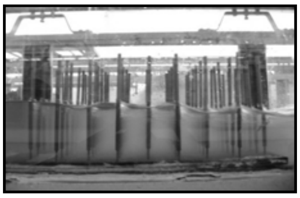
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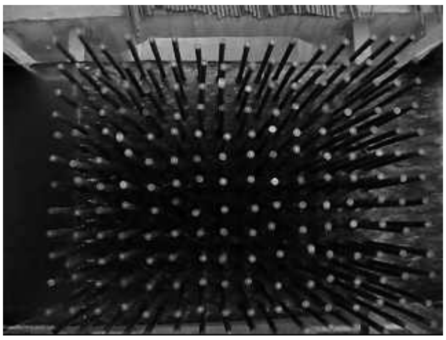
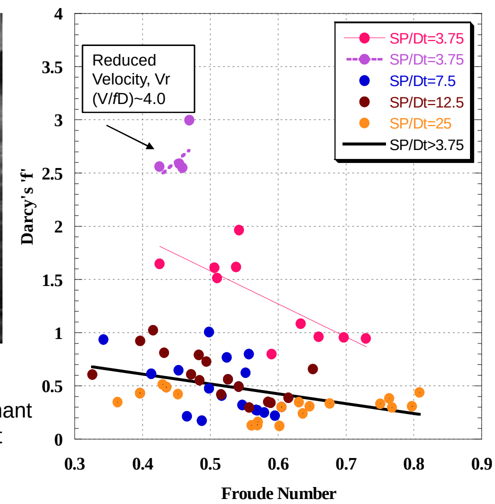
RESISTANCE IN TERMS OF DARCY'S *f* IN STEADY UNIFORM FLOW





SP/D ~3.75: Proximity Effect Predominant
Vr~4.0: Wake Effect Predominant

Department of Ocean Engineering,
Indian Institute of Technology Madras, Chennai, INDIA 600036,
e-mail: vsundar@iitm.ac.in

SUMMARY

Utility of the newly proposed Relative Rigidity

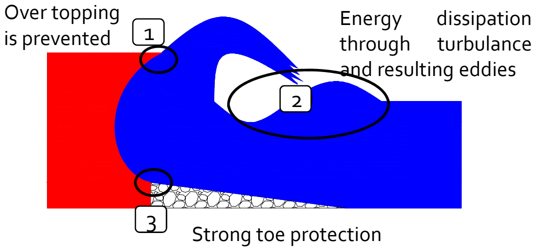
A Design Example

Properties	Oak tree[Light]	Casurina[Medium]	Mangrove[Heavy]
E	9Gpa	14Gpa	18.5Gpa
Dt	0.267 m	0.267 m	0.267 m
λ	1	1	1
f_1	0.3037	0.37	0.43
Vr	51.9	41.6	36.2
SP/Dt	6	6	6
RR	3.87	4.02	3.98
Design BG	120 m	80 m	60 m

SEAWALLS-THE HARD PROTECTIVE MEASURE

Characteristics of an ideal seawall are

- **Less reflection and Run-up**
- **Optimum use of coastal space**
- **Less or no wave overtopping**
- **Lower crest elevation**
- **Less maintenance costs**



This objective may be achieved by considering a front shape of the structure, which forms the main objective of the present study.

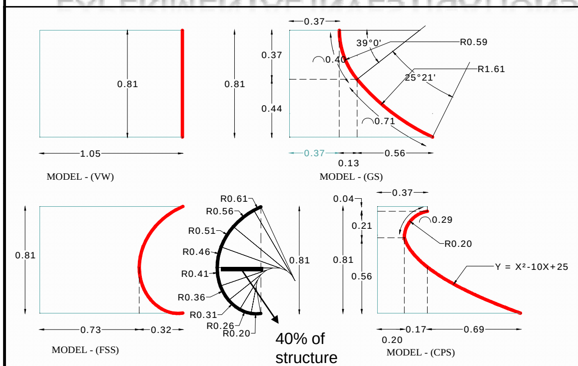
It is evident that a seawall as a coastal protection measure should be effective with an optimum use of the coastal space, with less or no wave overtopping by maintaining a lower crest elevation.

This in fact can also enhance the scenic beauty of the oceanic view.

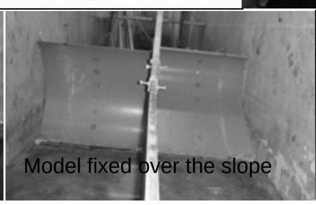
Hydrodynamic characteristics of different shapes of Seawalls

Department of Ocean Engineering,
Indian Institute of Technology Madras, Chennai, INDIA 600036,
e-mail: vsundar@iitm.ac.in

EXPERIMENTAL INVESTIGATIONS



Model (**VW**) Vertical wall
Model-(**GS**) Galveston seawall, (Coastal Engineering Manual, 2006)
Model-(**FSS**) Flaring shaped seawall, (Kamikubo, et al., 2000)
Model-(**CPS**) Circular cum parabolic seawall, (Weber, 1934)

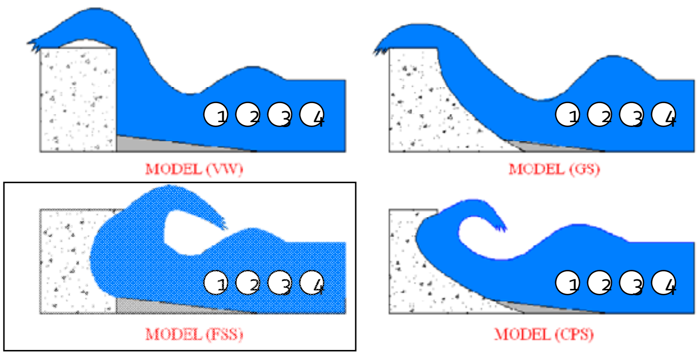


SUMMARY AND CONCLUSIONS

Various configurations of seawall tested and compared

Run-up ⇨ 1
Dynamic Pressure ⇨ 2
Reflection ⇨ 3
Overtopping ⇨ 4

◯ LOW / GOOD ◯ HIGH / POOR



Department of Ocean Engineering,
Indian Institute of Technology Madras, Chennai, INDIA 600036,
e-mail: vsundar@iitm.ac.in

DIFFERENT TYPES OF ARMOUR BLOCKS

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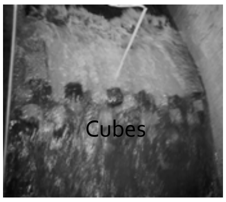
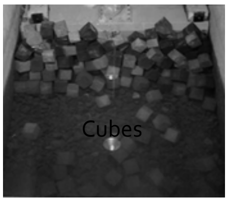
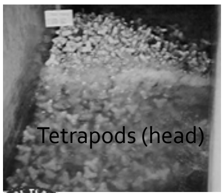
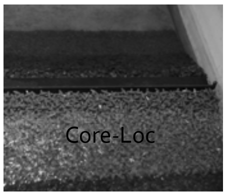
Indian Institute of Technology Madras, Chennai, INDIA 600036,
e-mail: vsundar@iitm.ac.in









Department of Ocean Engineering,
Indian Institute of Technology Madras, Chennai, INDIA 600036,
e-mail: vsundar@iitm.ac.in

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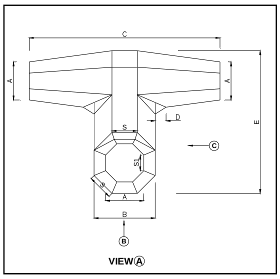
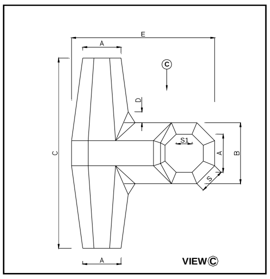
'KOLOS' artificial armour units

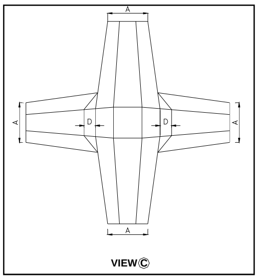
- KOLOS
  - Modified version of DOLOS armour units.
  - Re-designed the DOLOS units by reducing the distance between the vertical arms
  - Reduced susceptibility to fail at the junction of the horizontal and vertical arm due to wave action.

Department of Ocean Engineering,
Indian Institute of Technology Madras, Chennai, INDIA 600036,
e-mail: vsundar@iitm.ac.in

'KOLOS'
Dimensions





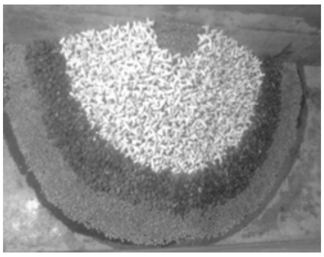


WEIGHT (tonnes)	12	8	5	4	2
VOLUME (m^3)	5.0	3.33	2.083	1.667	0.833
A (m)	0.659	0.576	0.493	0.457	0.363
B (m)	1.055	0.922	0.789	0.732	0.581
C (m)	3.297	2.881	2.465	2.287	1.816
D (m)	0.188	0.164	0.141	0.130	0.104
E (m)	2.473	2.161	1.849	1.715	1.362
S (m)	0.439	0.383	0.328	0.304	0.242
S1 (m)	0.274	0.239	0.205	0.190	0.151

Department of Ocean Engineering,
Indian Institute of Technology Madras, Chennai, INDIA 600036,
e-mail: vsundar@iitm.ac.in

'KOLOS'
Establishment of stability coefficient
(breakwater trunk and head sections)

Breakwater sections with trunk slopes 1 in 1.5, 1in 2 and 1 in 2.5 armoured with KOLOS



Breakwater heads section with slope 1 in 1.5 armoured with KOLOS

Trunk Slope	Hudson's stability coefficient for trunk (K_D)		
	Zero Damage	Upto 0.5% Damage	Upto 1% damage
1 in 1.5	23	32	35
1 in 2.0	19.5	27	-
1 in 2.5	14	23	-

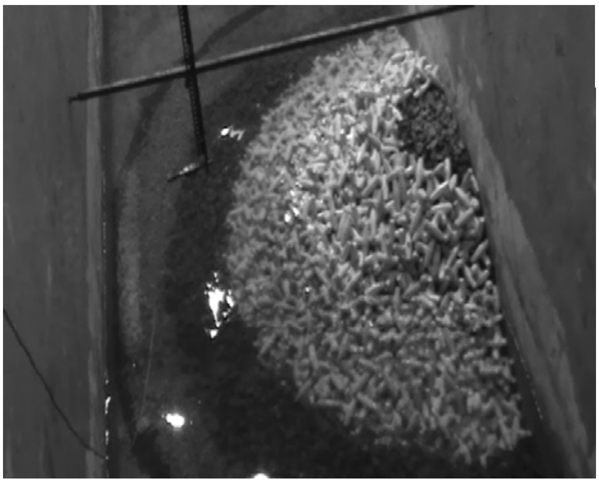
Trunk Slope	Hudson's stability coefficient for head (K_D)		
	Zero Damage	Upto 0.5% Damage	Upto 1% damage
1 in 1.5	6.5	8	-
1 in 2.0	4.5	5	-
1 in 2.5	3	3.5	-

Department of Ocean Engineering,
Indian Institute of Technology Madras, Chennai, INDIA 600036,
e-mail: vsundar@iitm.ac.in

Testing Of Breakwater TRUNK Sections
(for the establishment of stability coefficient of KOLOS)

Department of Ocean Engineering,
Indian Institute of Technology Madras, Chennai, INDIA 600036,
e-mail: vsundar@iitm.ac.in

Testing Of Breakwater HEAD Sections
(for the establishment of stability coefficient of KOLOS)



Department of Ocean Engineering,
Indian Institute of Technology Madras, Chennai, INDIA 600036,
e-mail: vsundar@iitm.ac.in

ARTIFICIAL BEACH NOURISHMENT

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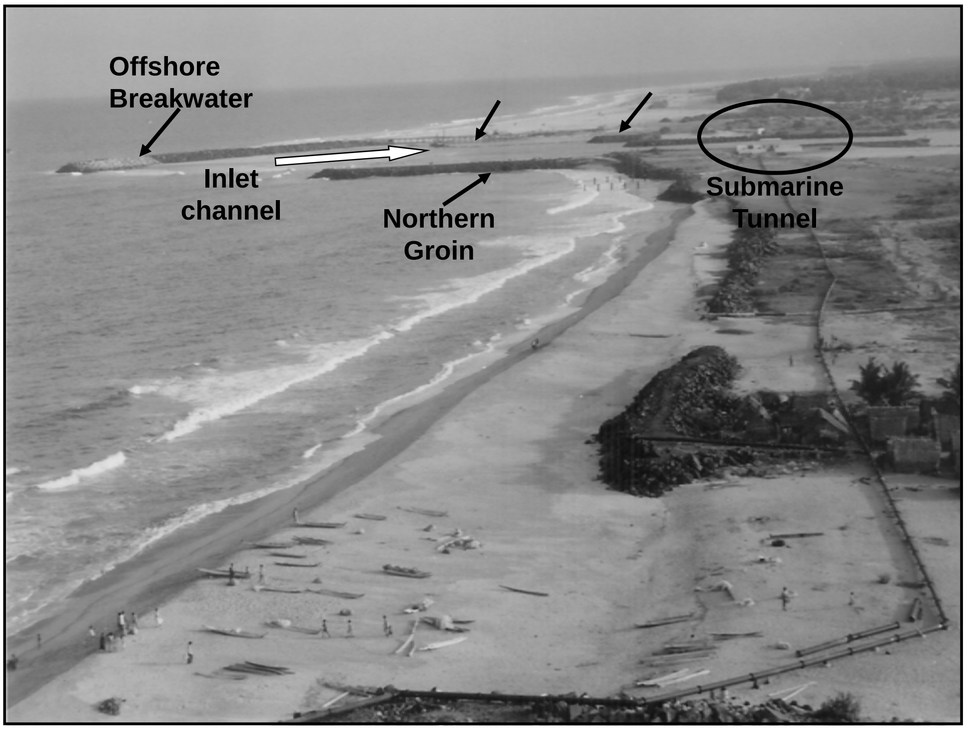


BEFORE SAND BYPASSING
January 2002

AFTER SAND BYPASSING
October 2002

A VIEW OF SHORELINE NEAR GANDHI STATUE

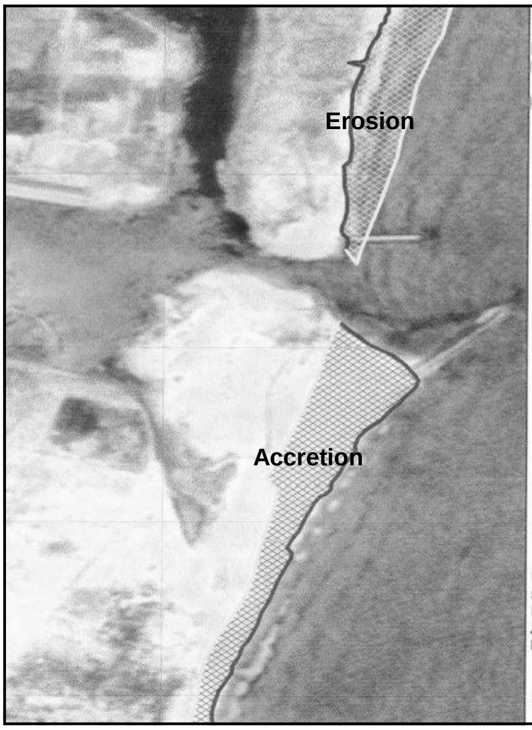
A VIEW ON NORTH SIDE
OF GANDHI STATUE
(BEFORE SAND BYPASSING)
January 2002

FORMATION OF
BEACH ON
NORTH SIDE OF
GANDHI STATUE
(AFTER SAND
BYPASSING)
October 2002

BEFORE SAND BYPASSING
January 2002

AFTER SAND BYPASSING
October 2002

A VIEW OF SHORELINE NEAR NORTH SIDE OF JETTY



The erosion and accretion is estimated from 1986 to 2002, i.e., over a period of 16 years with the satellite imagery data using GIS software.

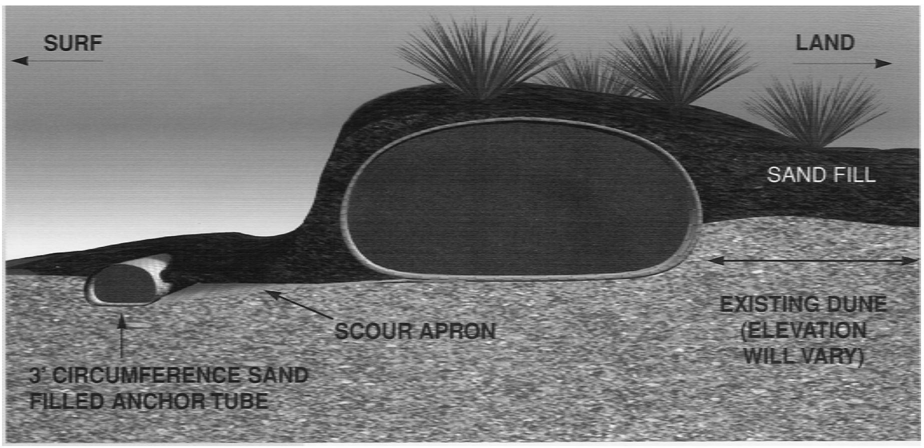
The rate of erosion is about 4m per year and the accretion is 6m per year.

The extent of erosion in the northern side is 33.59 hectares compared to the accretion on southern side of 30.71 hectares..

GEO-SYNTHETICS

Department of Ocean Engineering, Indian Institute of Technology Madras, Chennai, INDIA 600036, Tel.: 91-044 - 22578622; e-mail:vsundar@iitm.ac.in

GEO-Tubes



Cross-section showing installation of the Mirafi ® Geotube ® in a typical sand dune

Filling operation of the Mirafi ® Geotube ® : Fill Material is pumped into the tube, displacing the water. Typical water/sand ratio during pumping is 90% water, 10% sand

GEO-BAGS protection for Island of Sylt, Germany

Location map of the site

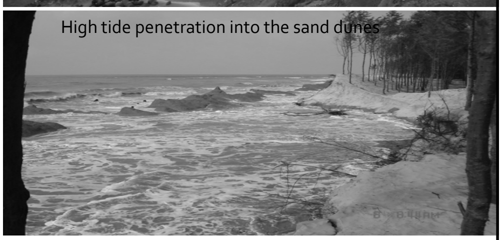
WEST BENGAL

STATUS OF THE COAST in mid 2007

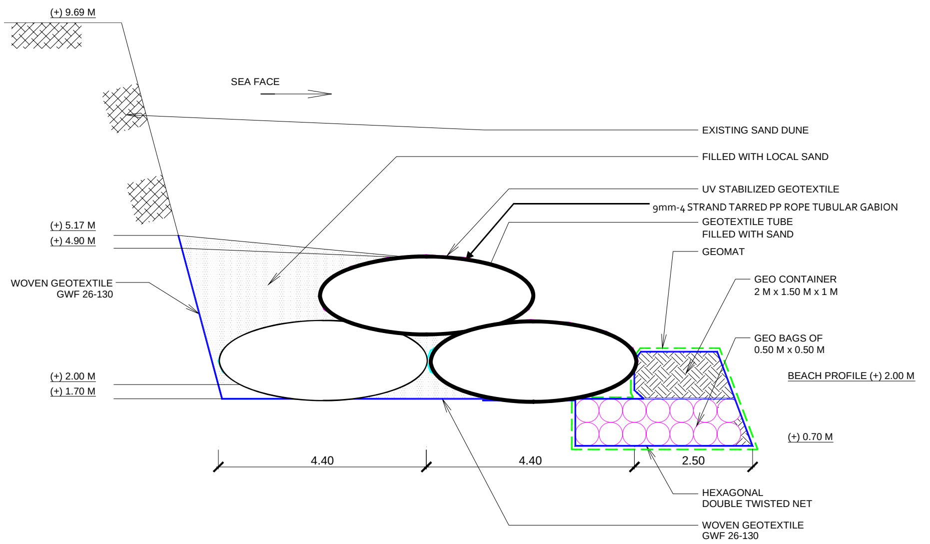

Dhiga beach- view towards east of SeaHawk hotel


Usage of Ballas on the eastern side of the coast near the road near Chandpur

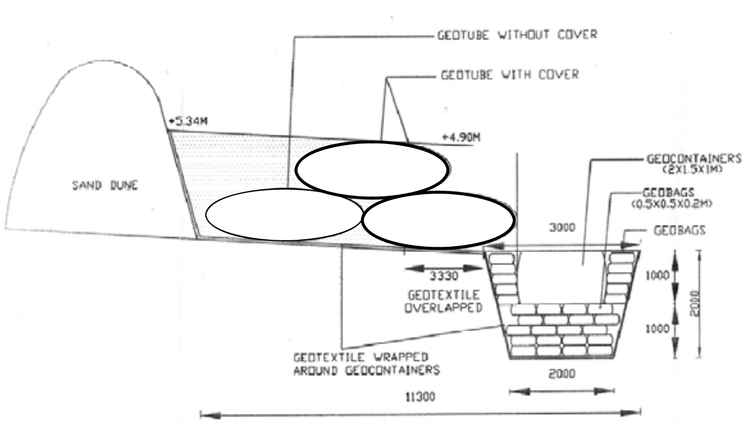

Usage of Ballas on the western side of the coast near the road near Chandpur


High tide penetration into the sand dunes

Initial section considered



Completed Structure



Revised section adopted

STATUS OF THE COASTAL PROTECTION FROM MID 2007 TO EARLY 2008

MEASUREMENT CAMPAIGN-TIDAL INLETS

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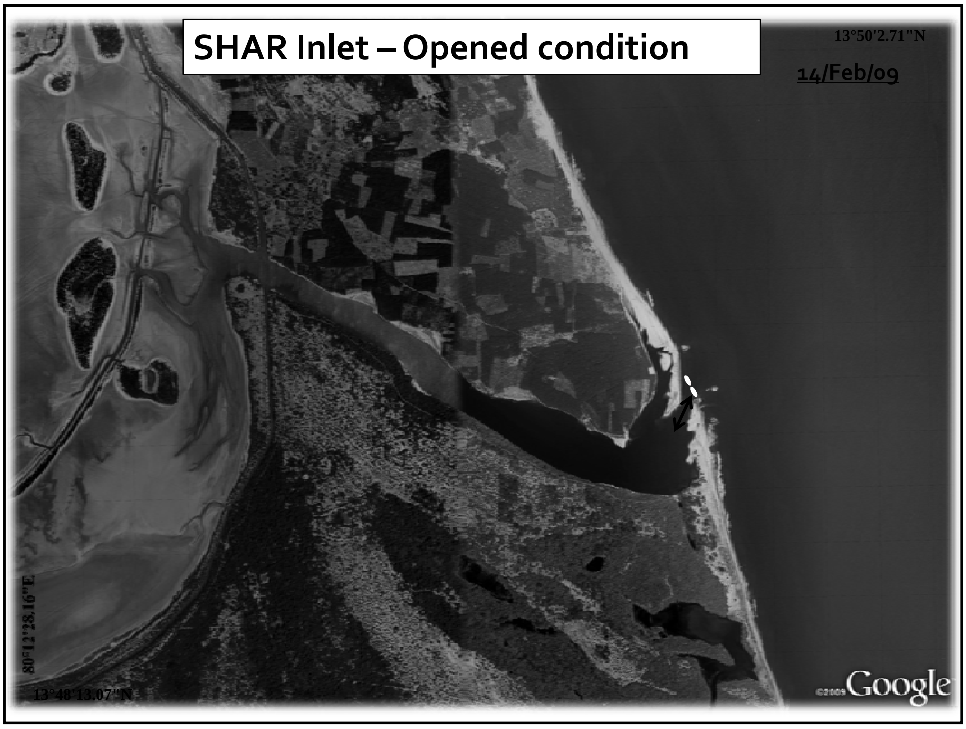
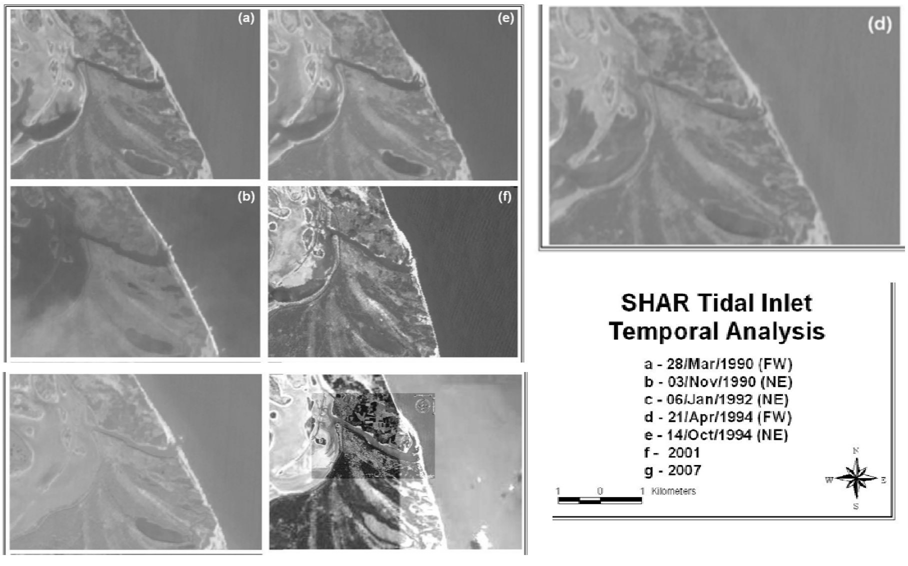
SHAR Inlet – Opened condition



MORPHOLOGICAL CHANGES AT SHAR INLET (1990 – 2007)



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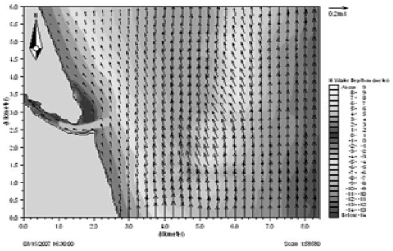
Inlet Management at SHAR inlet



A pilot project aims at assessing

1. Functional
2. Structural

NIOT

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✓Analysis of morphological changes

✓Field investigations

✓Numerical Modelling

✓Design of Geotextile based training jetties

✓Implementation and post monitoring

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SPECIFIC RECOMMENDATION OF THE WORKSHOP (AUG 2010)

- Selection and specification of geo-synthetic properties for various applications (revetments, shore protection, breakwaters, geo-systems, etc.)
- Influence of fill-ratio on performance on design and performance of geo-systems
- Influence of fill material on performance (sand, mud, silt materials, clay, coarse materials, saturated, unsaturated, etc.)
- Hydraulic interactions; reflection, transmission, permeability, roughness
- (More) Uniformity in stability formulations and limits of application in various applications (on slope, offshore, submerged, emerged, singular, stacked, etc.))
- Internal (in-)stability of system (internal migration)
- Scour prediction and protection

Department of Ocean Engineering, Indian Institute of Technology Madras, Chennai, INDIA 600036, Tel.: 91-044 - 22578622, e-mail:vsundar@iitm.ac.in

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- Stimulating research in field of geo-systems
- Clear definition of applicability of woven and non-woven materials and proper guidelines
- Durability of geo-synthetics and geo-systems for tropical weather conditions
- Accuracy of placement of geo-systems
- Review of construction techniques (uniform pumping geo-tubes, anchoring, filling and releasing geo-containers-stacking units, etc.)
- Techniques for the removal of damaged units.
- Construction specifications
- Quality control (strength of seams and length effect)
- Cost effectiveness of geo-systems compared to conventional structures
- Monitoring techniques
- Involving clients in research and systematic monitoring
- Preparing (and regular updating) of design guidelines
- Improving exchange of knowledge (forming of working groups within IAHR or similar organisations)
- Organizing a forum/platform for contacts and exchange of information (how to avoid confidentiality ?)

THANKS FOR YOUR KIND ATTENTION

Department of Ocean Engineering, Indian Institute of Technology Madras, Chennai, INDIA 600036, Tel.: 91-044 - 22578622, e-mail:vsundar@iitm.ac.in