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GARWARE-WALL ROPES LTD.

SEA WALL EMBANKMENT AT PENTHA, ODISHA - AN INDIAN EXPERIENCE ON SEA SHORE PROTECTION USING GEOTEXTILE TUBES

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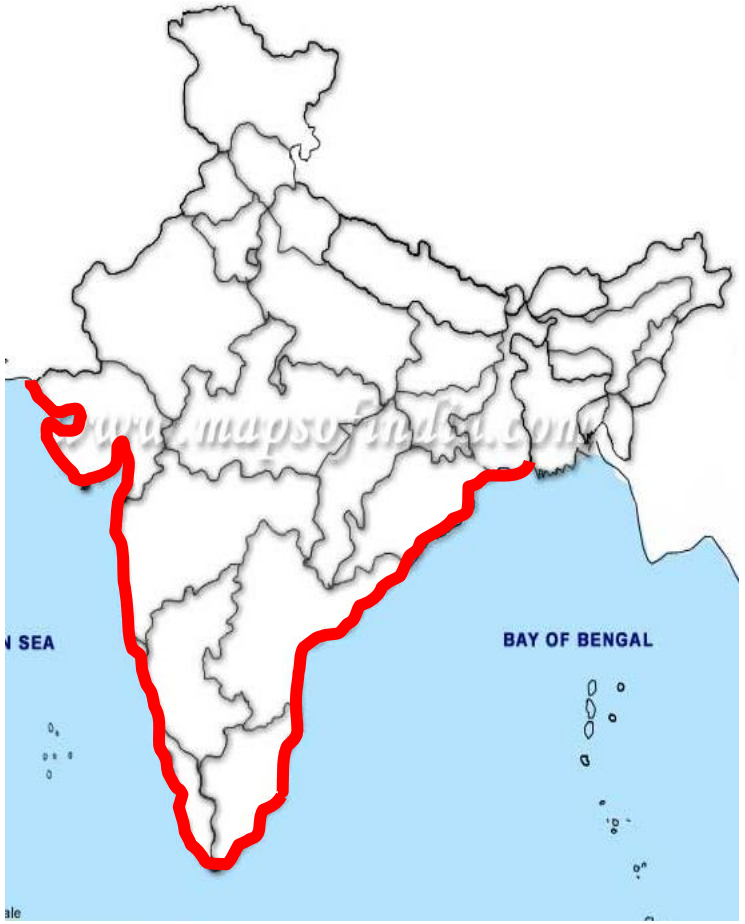
President & Head

Geosynthetics Division

INTRODUCTION

- India :
  - Peninsula
  - Vast Coast Line, 5700 km
- Coast Line :
  - Valuable old monuments
  - Large number of habitations
  - Several industries
- Natural Forces :
  - Tidal level variation
  - Storms



INTRODUCTION

- **Commonly adopted structures to impede the actions of waves :**

  Seawall, Spurs, Dykes, Groynes,

  Groynes, Shore revetments

- **Conventional structures :**

Material → Masonry, Concrete } Cost Prohibitive

Performance → Undue Distress → Settlement
Large Wave Action

INTRODUCTION

• Odisha has a coast line of around 480 m and famous for unique array of biological and ecological diversities.

• Over the years, the behaviour of the sea is changing rapidly, threatening the lives and livelihood of coastal people.

•Paradeep - Dhamara stretch is one particular stretch in the Odisha coast which has been ravaged by Super Cyclone twice in the last forty years during 1971 & 1999 and very- severe cyclone during 2013 (Phailin) & 2014 (Hud Hud).

• Pentha is a sea shore village of Rajnagar block in the Kendrapara district located south of Dhamara in the Paradeep – Dhamara stretch, which has lost considerable coastal area.

INTRODUCTION

Image courtesy : Wikipeadia

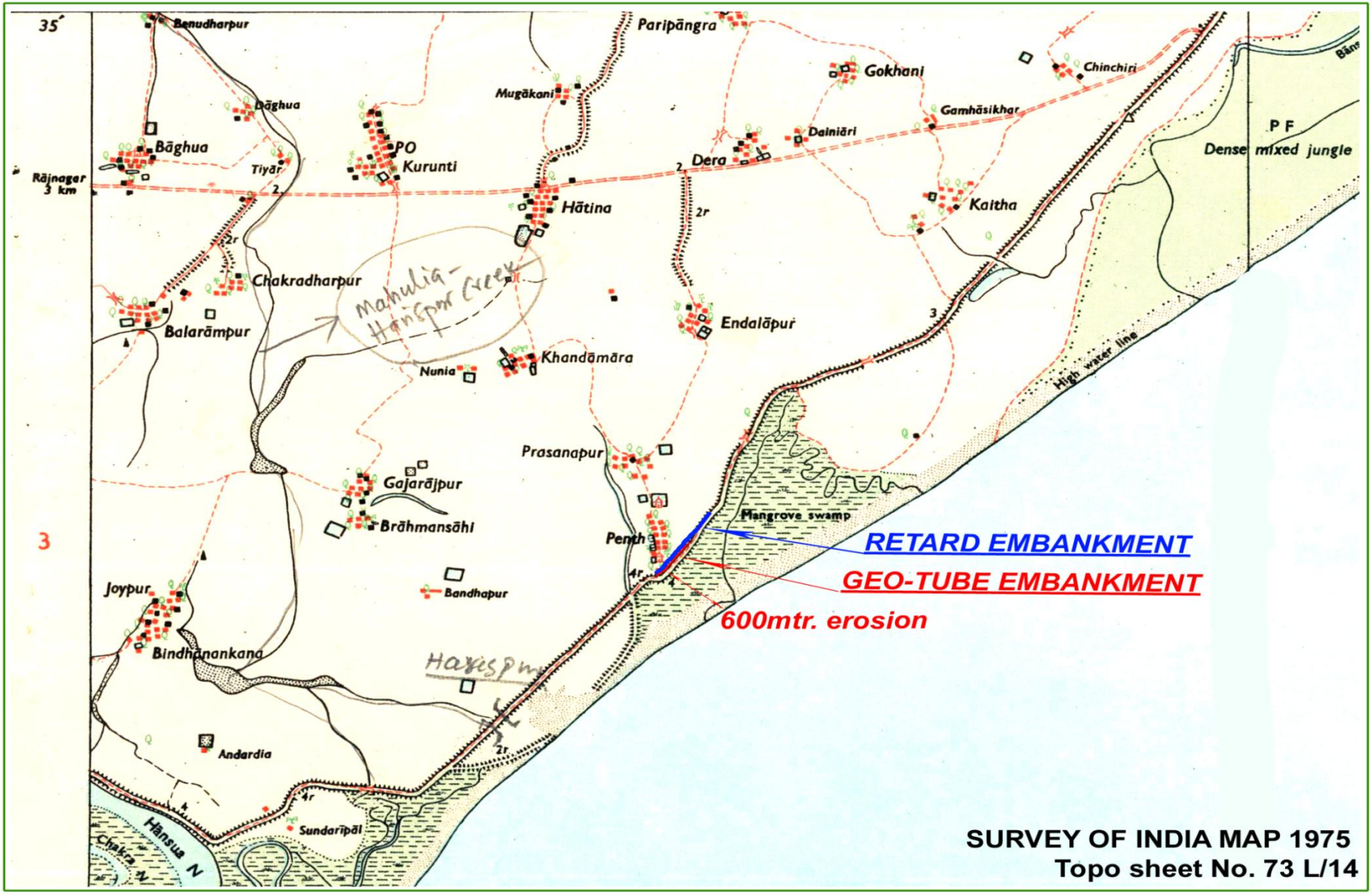
INTRODUCTION

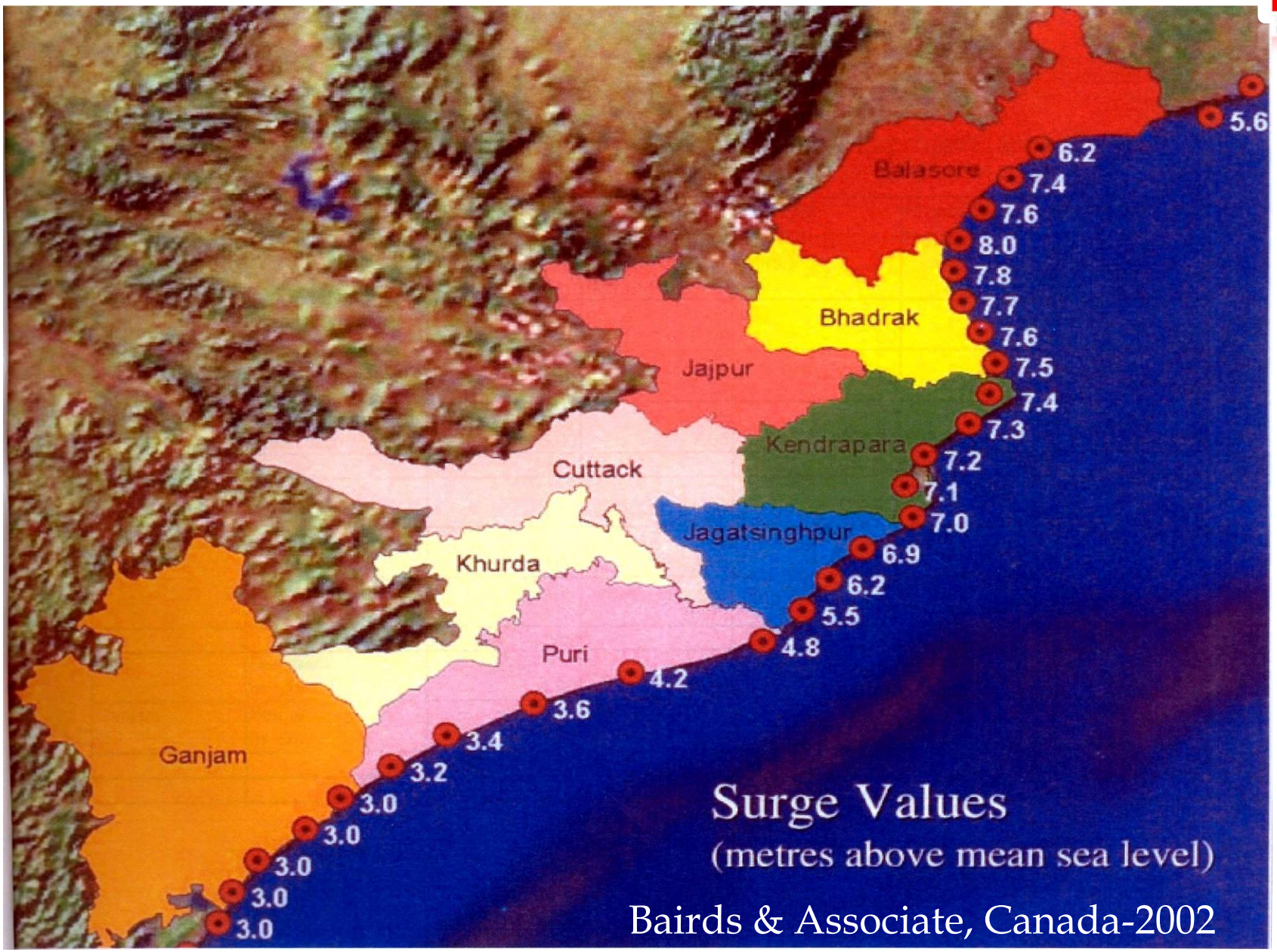
•The shore line near the village has advanced about 500 metres since 1999.

Year	Distance of shoreline from existing earthen embankment
2005	200 m
2006	100 m
2007	20 m
2008	10 m
2009	5 m
2011	Shore line over-ran the old embankment

Problem faced: contd…

- In 2008, shoreline was 20m away from existing old embankment.
- Traditional method of protection using wooden stump piling and Big Resin PVC sand bag dumping was done every year.
- In the Year 2009-10, a retard embankment was constructed on the backside of the old embankment at a distance of 60 metre
- In 2011-12, the shoreline over-ran the old embankment for a length of 400 metre & washed away the embankment for 350 metre length.


35´
Benudharpur
Paripāngra
Gokhani
Chinchiri
Mugākani
Dāghua
Gamhāsikhar
Dainiāri
Bāghua
PO
Kurunti
Tiyār
Dera
Rājnagar
3 km
Hātina
Kaitha
P F
Dense mixed jungle
Chakradharpur
Mahulia-
Hanspur creek
Balarāmpur
Endalāpur
Nunia
Khandāmāra
High water line
Prasanapur
Gajarājpur
Brāhmansāhi
Mangrove swamp
Penth
RETARD EMBANKMENT
GEO-TUBE EMBANKMENT
600mtr. erosion
Joypur
Bandhapur
Bindhānankana
Andardia
Sundaripāl
Hansua N
Chakra N
SURVEY OF INDIA MAP 1975
Topo sheet No. 73 L/14


Balasore
Bhadrak
Jajpur
Kendrapara
Cuttack
Jagatsinghpur
Khurda
Puri
Ganjam
5.6
6.2
7.4
7.6
8.0
7.8
7.7
7.6
7.5
7.4
7.3
7.2
7.1
7.0
6.9
6.2
5.5
4.8
4.2
3.6
3.4
3.2
3.0
3.0
3.0
3.0
3.0
Surge Values
(metres above mean sea level)
Bairds & Associate, Canada-2002

Traditional methods

•Traditional method of protection of embankment using ‘Bullah piling’ and big resin PVC sand bags (2m x 1m 1 m) dumping was being done every year.

Pictures of the site: (Dt. 20.10.2011)

400 metre length of embankment as protected earlier by sand bags are fully washed by high surge

Pictures of the site: (Dt. 11.01.2013)

400 metre length of embankment as protected earlier by sand bags are fully washed by high surge

Traditional Methods - Shortcomings

•In 2011, several times all these conventional protection works were washed away during the low pressure periods.

•The existing embankment was fully washed away on 19th November 2011 for a stretch of 350 meters.

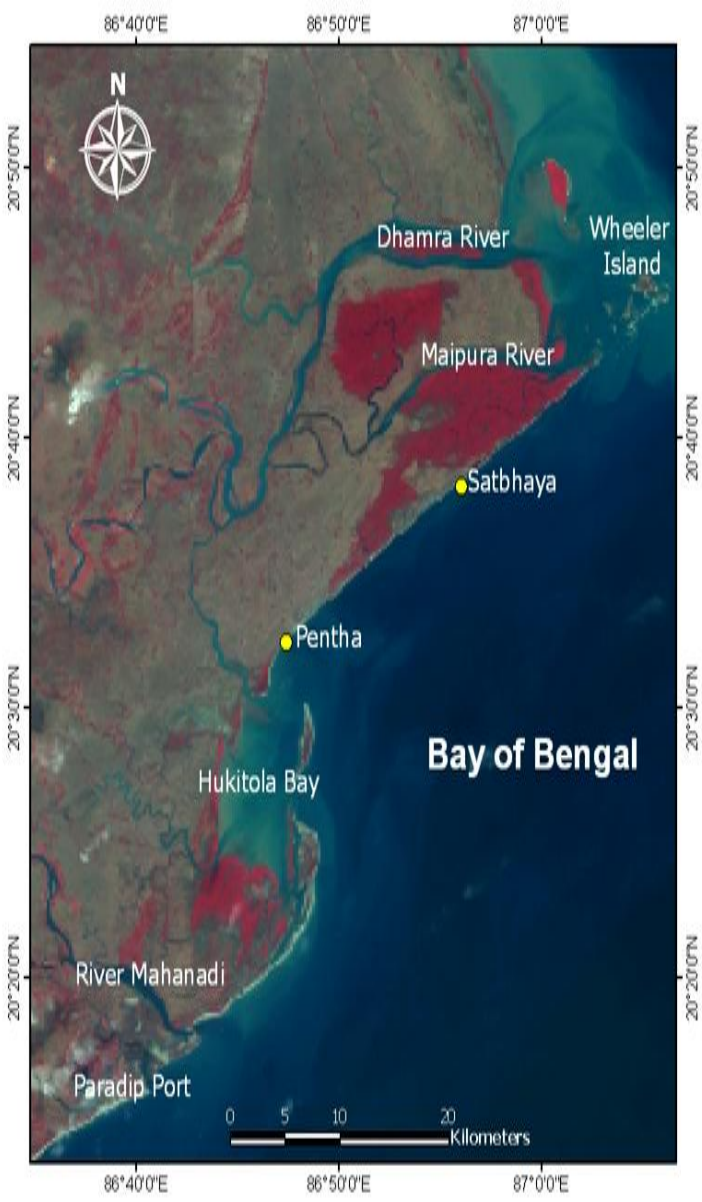
•The conventional methods proved ineffective as a permanent solution to protect the shore from further erosion.

Geotextile tube sea embankment

- As a permanent solution to the protect the existing embankment, the habitation of Pentha and adjoining villages and immediate cultivable land, sea wall of 505 meters with geotextile tubes as core was conceptualised.

- The project is funded by the World Bank under Integrated Coastal Zone Management Project (ICZMP).

- The designs are prepared by Dept. of Ocean Engineering IIT Madras and the GWRL has been awarded the work.

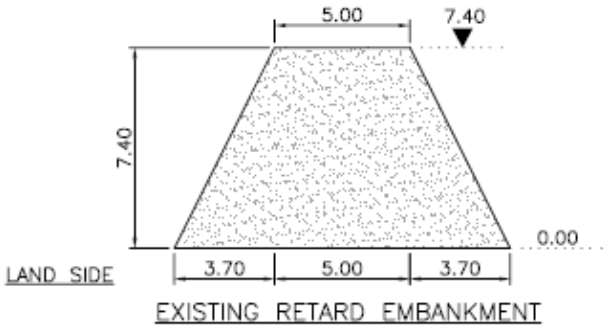


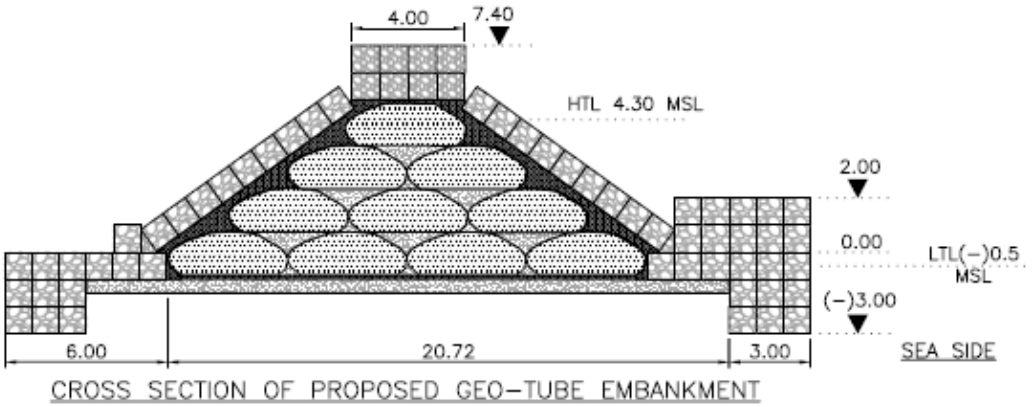
-: *FUNDED BY* :-

INTEGRATED COASTAL ZONE MANAGEMENT PROJECT (ICZMP) , ODISHA

DEPARTMENT OF WATER RESOURCES
GOVERNMENT OF ODISHA

Embankment as per original approved drawing (30m base width)





GABION BOX : SCOUR APRON AND TEO MOUND 35 Nos /2RM
FOR 675m = 11810
FOR SIDE SLOPE AND TOP 26 Nos /2RM FOR 675m = 8775
ADD FOR 2 END CONNECTING PORTION 2X105 = 210
ADD FOR 5% RESERVE STOCK 1040
TOTAL =21835 Nos

Then came Phailin

- Work awarded on 24 -07 - 2013 and Phailin hit on 12-10-2013

- Modification in the design due to advancement of shoreline towards retarded bund.

- Alignment of protection work is shifted towards the retarded embankment.

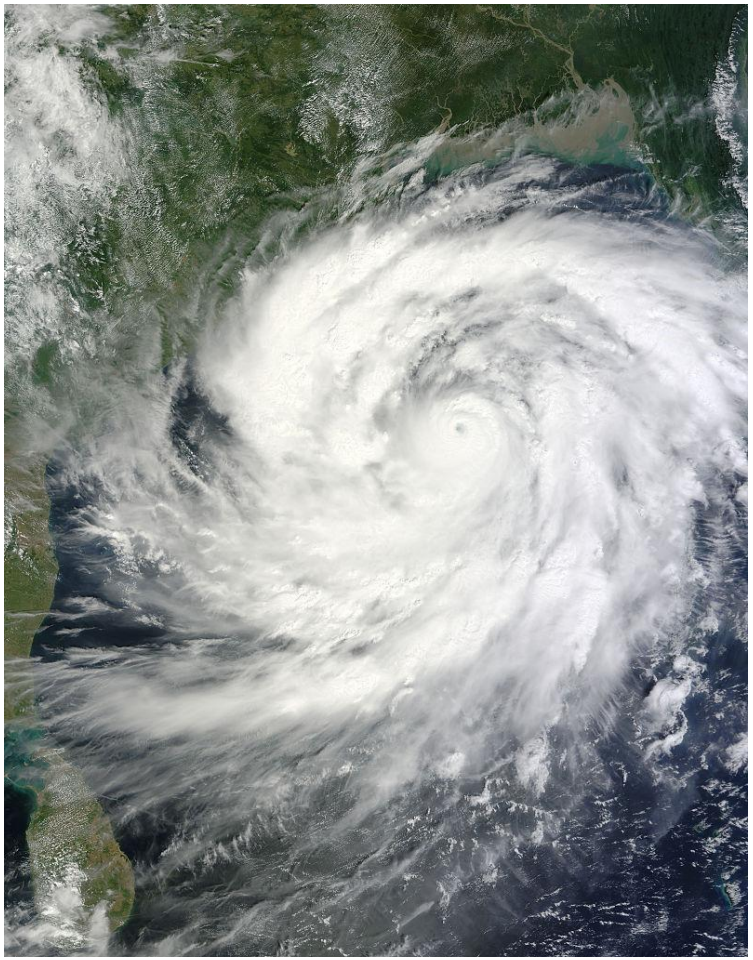
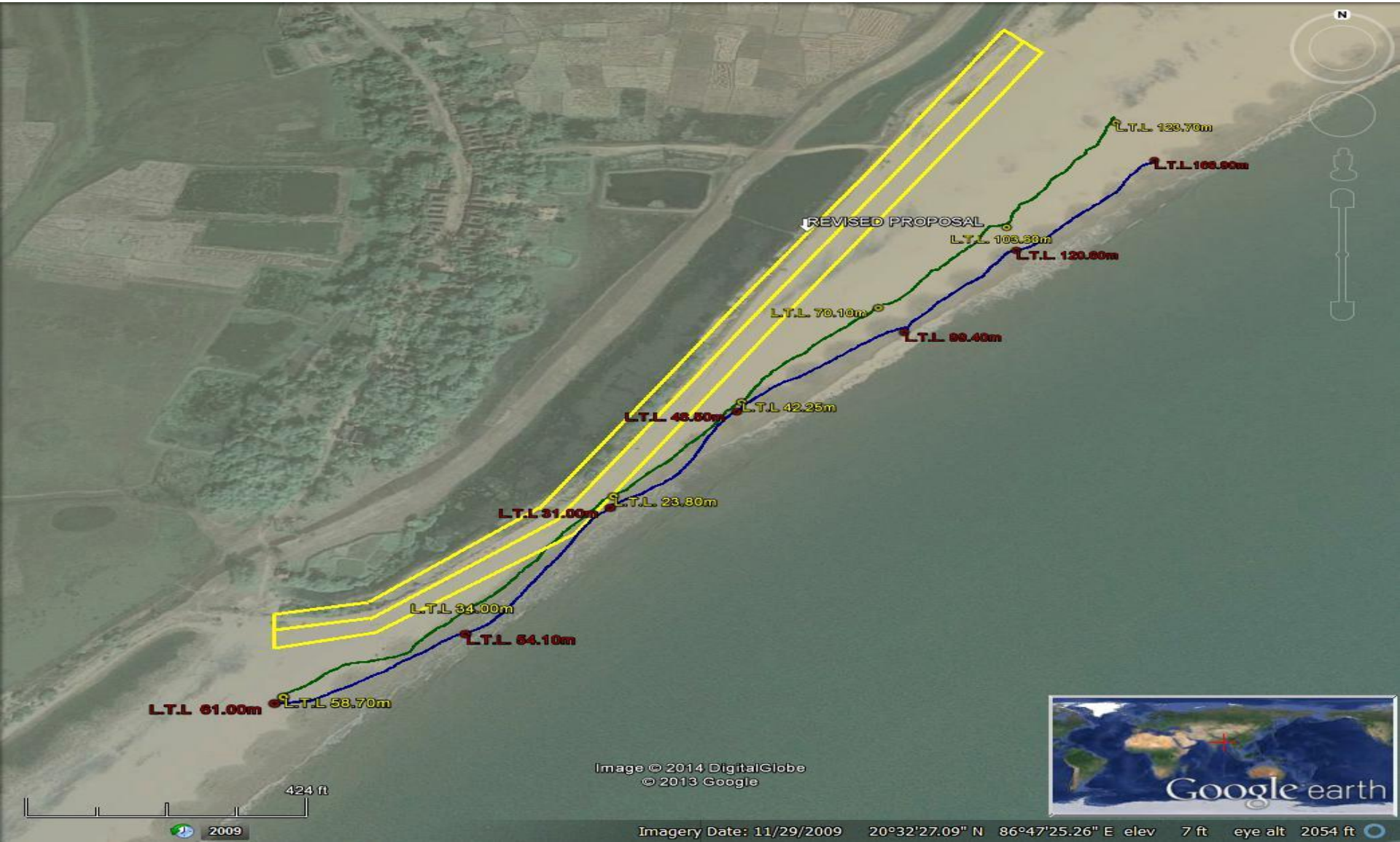
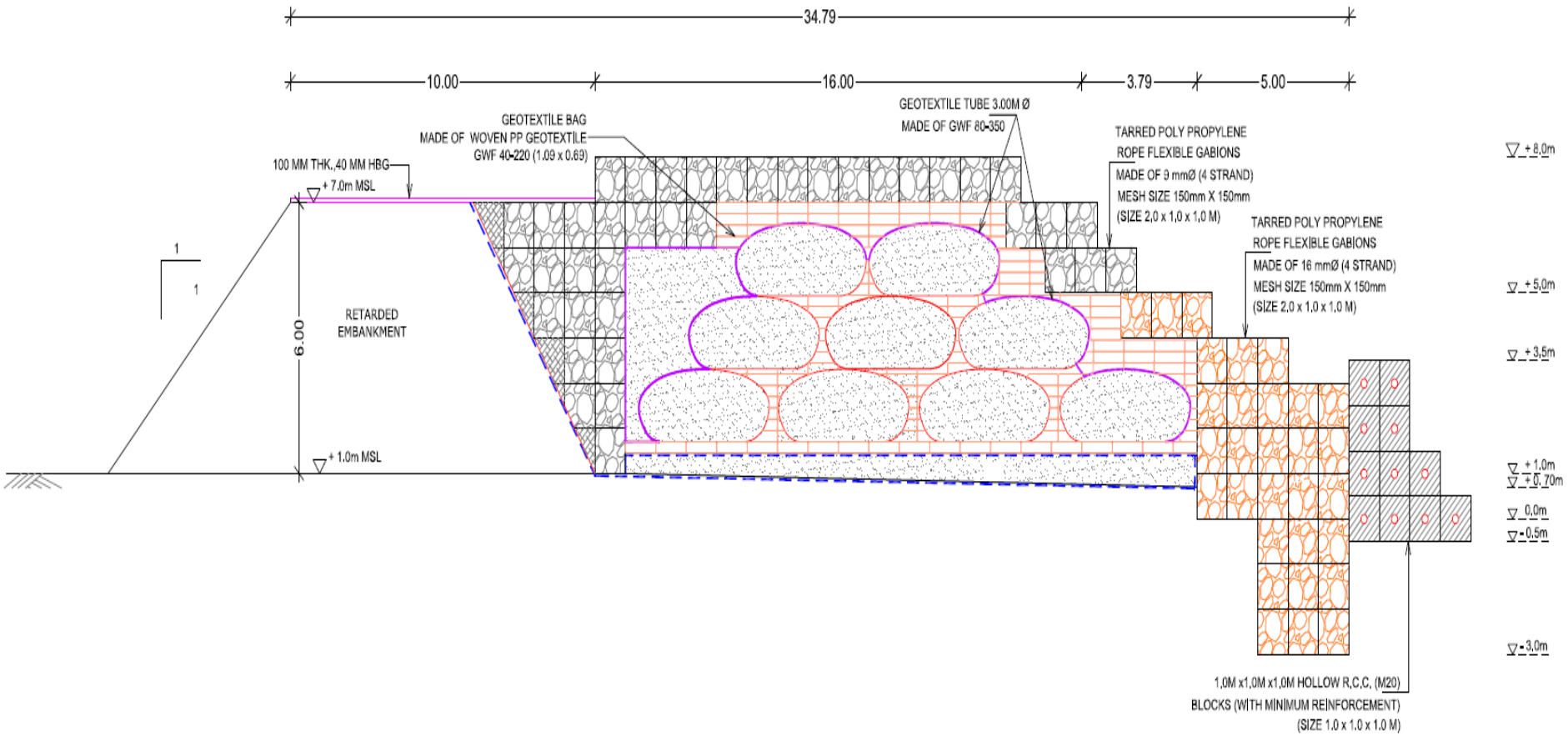


Image courtesy : Wikipeadia

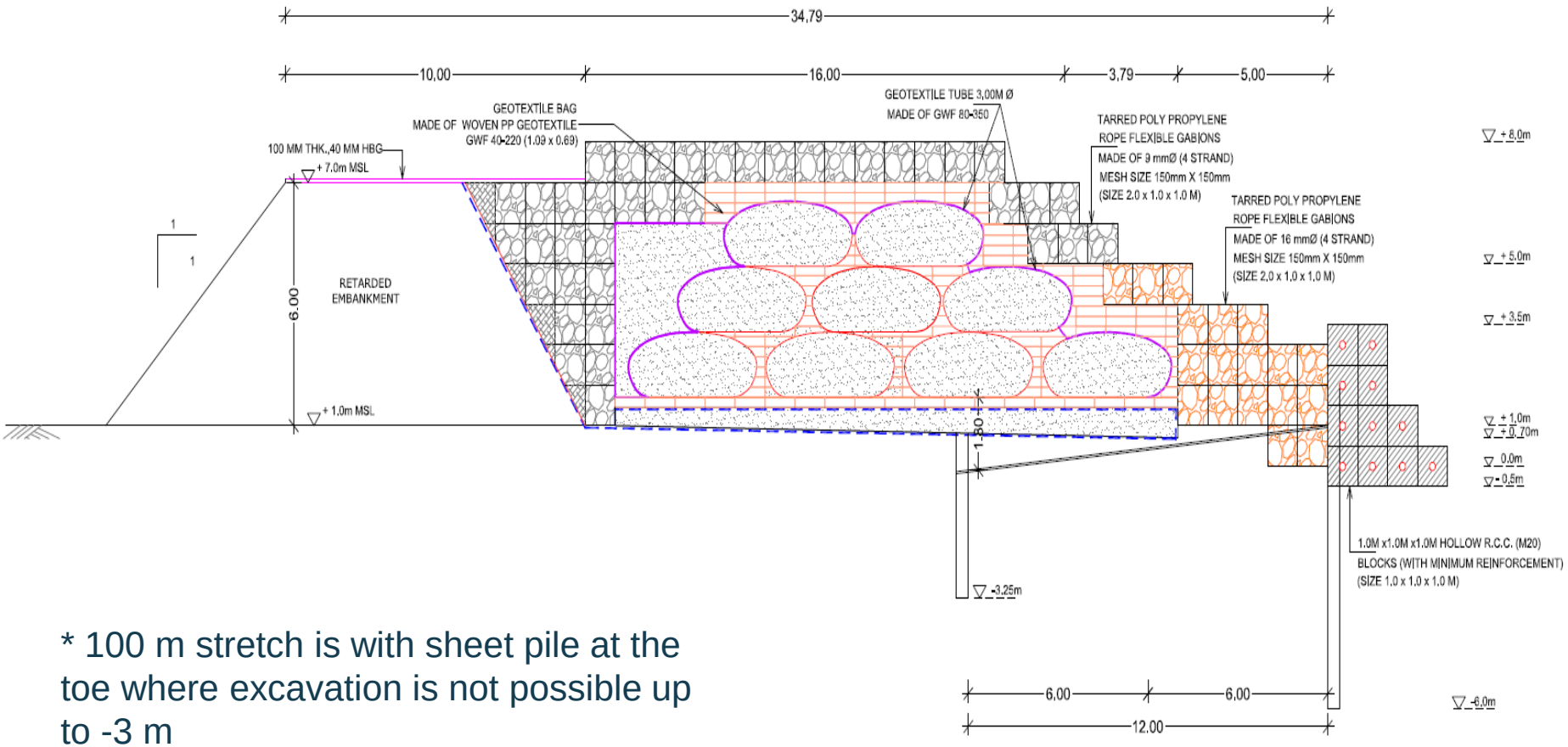
TOPOGRAPHICAL ALIGNMENT OF REVISED EMBANKMENT WITH L.T.L IN 2011 AND 2013



Final Design



Final Design



* 100 m stretch is with sheet pile at the toe where excavation is not possible up to -3 m

Installation

•A trench of 3 m deep and 3 m wide was constructed and filled with polypropylene (PP) gabion of size 2 m x 1m x 1m. This was the most challenging activity of the construction of whole structure, for it had to be timed with the low tide spell .

•But for a 100m, it was found trenching a daunting task, and at this stretch sheet piles were installed for scour protection. Two rows of sheet piles - one at the sea side was driven 6 m into the ground and the other towards land side was driven 3.25m. The rows of the sheet piles were connected by tie rods at regular intervals.

Installation

Installation of PP rope gabion

Filling of PP rope gabion

Installation

Bed Preparation for Geotextile tube

The bed was first leveled and varying sand layer of thickness 0.45 m to 0.75 m was laid in between two 230 gsm geotextile layers. A layer of 20 mm aggregates was laid on top of it, followed by two layers of geotextile bags.

Installation

Installation of Geotextile tube

Filling of geotextile tubes was done after placing the empty geotextile tubes along the marked alignment and tied with temporary supports.

Sand stored in the hoppers and sea water were mixed and pumped carefully using 100 HP submergible pumps through four filling ports.

The activity demanded constant monitoring of pumping pressure and the mixing ration of sand to water for getting the required profile of geotextile tube.

Installation

Installation of Geotextile tube

Installation

A UV protection shroud layer was laid over the top of the filled geotextile tubes. The spaces in between the geotextile tubes were filled with geotextile bags of size 0.5 m x 0.5 m x 0.1 m.

Gabions made of 16 mm tarred PP ropes were laid around the whole geotextile tubes at the sea facing side of the structure. On the rear side, gabions made of 9 mm tarred PP rope were laid as the armour layer.

Installation of pumps on a barge to supply water for sand slurry

Geo tube laying starts after preparation of bed

Filling of Geo Tube

Installation photos

Installation photos

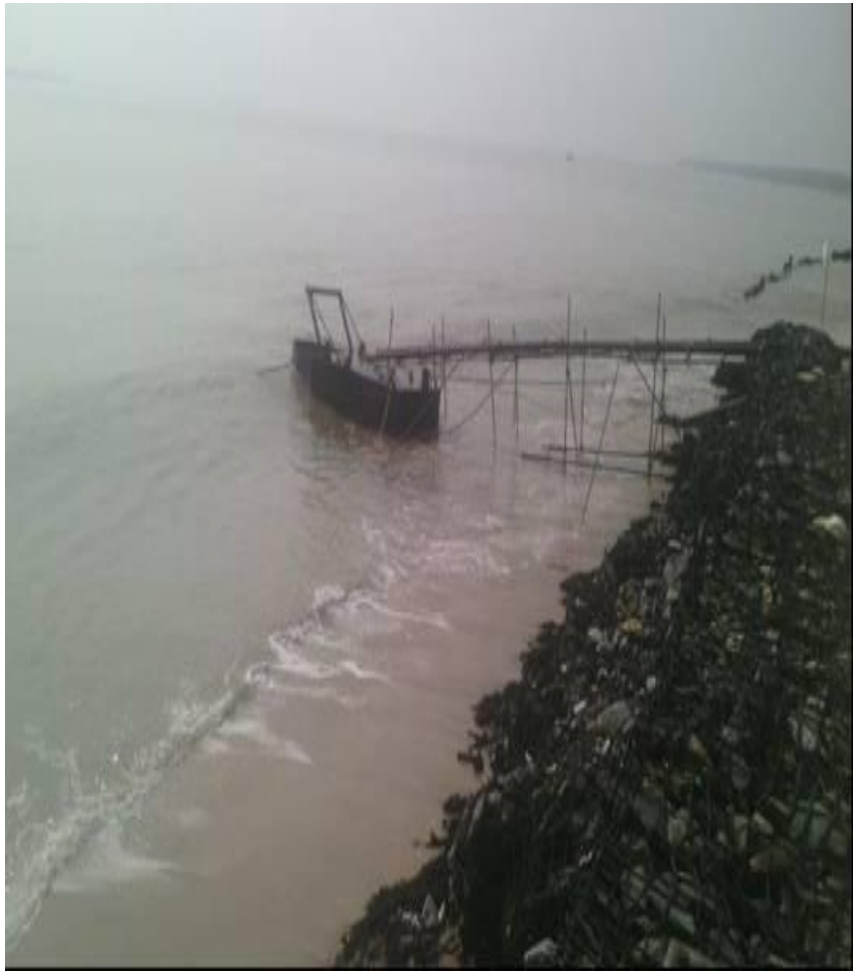
CONSTRUCTION AND DESIGN DIFFICULTIES

The ever changing shore line at Pentha necessitated constant redesigning of the structure; the cross-sectional drawings were revised constantly during the construction to incorporate the changes.

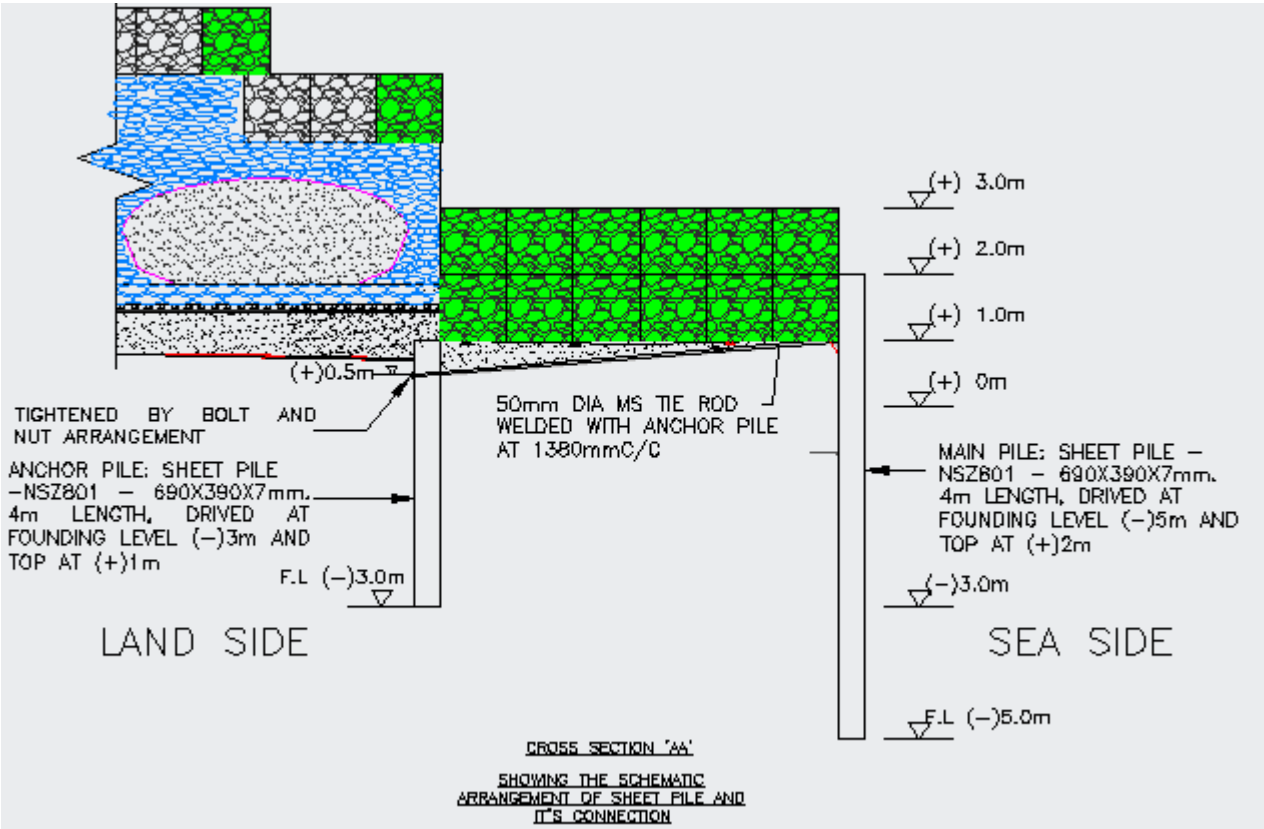
The construction of toe by trenching to a depth of 3 m was the critical activity, for it often resulted in retrenching once the tidal waves refills the excavations, slowing the construction pace.

CONSTRUCTION AND DESIGN DIFFICULTIES

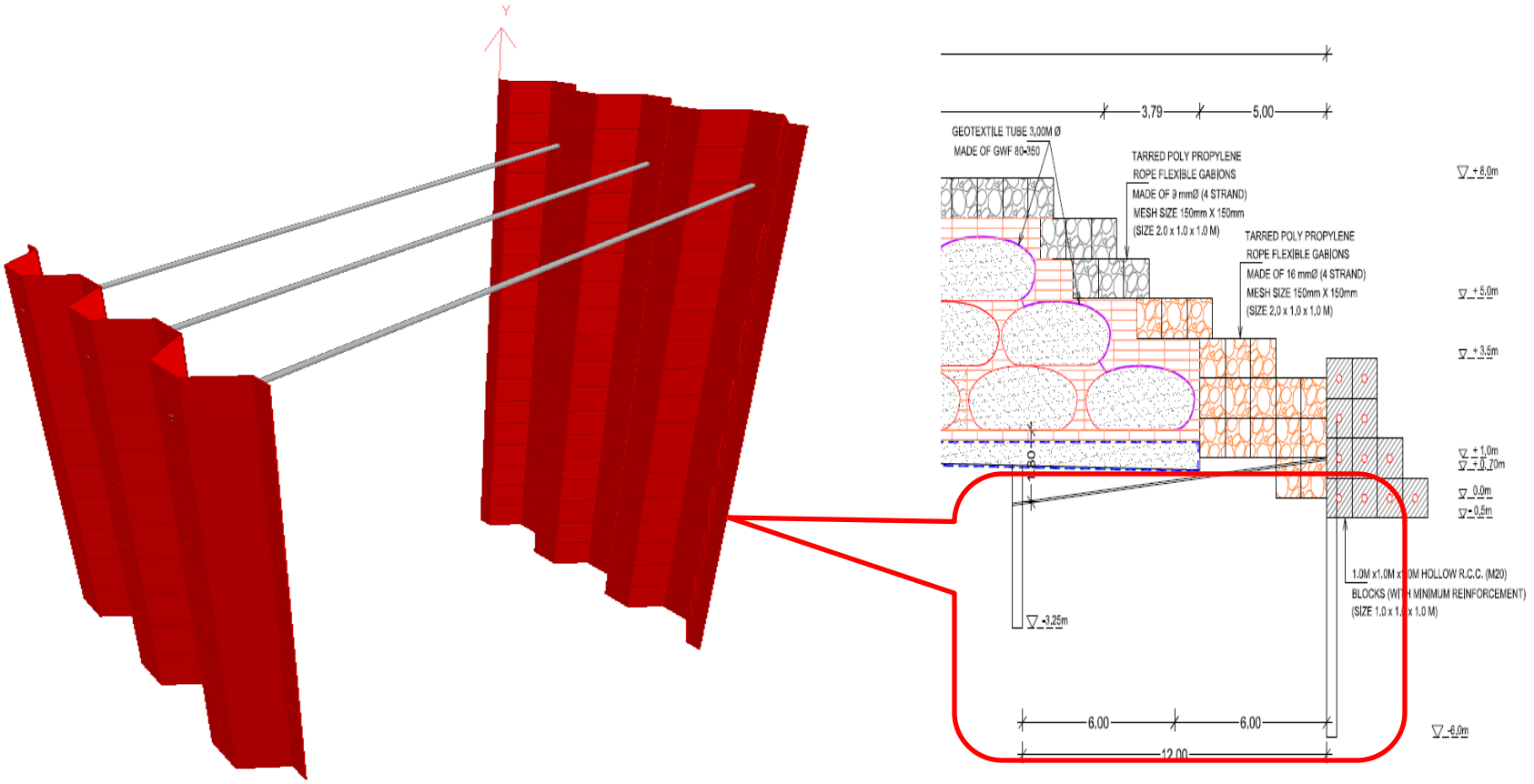
The initial stages of construction were to be timed with the tidal fluctuations. The other major problem was that Geotextile bags and other flotsam getting stuck in hydraulic pumps and hampering the filling of geotextile tubes. The problem was solved by constructing a barge to mount the pump and taking the inlet further deep into the sea.



Two row sheet piles installed in cut off zone for the most critical length of 100 mtr (RD 80 to 180 m)



3D view of sheet piles in two rows



Sheet pile being installed by using vibro hammers

Sheet pile driving in progress

Current Status

- The installation of the sea wall embankment was completed on 10th June, 2016.
- Being a pivotal project, it was featured in the Intergovernmental Panel on Climate Change (IPCC) as India's initiative on the environmental change.

Conclusion : Accretion of sand has started in front of Geo Tub

Accretion of sand has started in front of Geo Tube

Thank you

We look forward to hearing from you…

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