15 -ാം കേരള നിയമസഭ

11 -ാം സമ്മേളനം

നക്ഷത്ര ചിഹ്നം ഇല്ലാത്ത ചോദ്യം നം. 6377 **10-07-2024 - ൽ മറുപടിയ്ക്ക്**

പി.എം.എം.എസ്.വൈ. - വൈപ്പിൻ-മുനമ്പം തീര സംരക്ഷണം

ചോദ്യം		ഉത്തരം	
ശ്രീ. കെ.എൻ. ഉണ്ണികൃഷ്ണൻ		**ശ്രീ സജി ചെറിയാൻ (മത്സ്യബന്ധനം, സാംസ്കാരികം, യുവജനകാര്യ വകുപ്പ് മന്ത്രി)**	
(എ)	വൈപ്പിൻ-മുനമ്പം തീര സംരക്ഷണത്തിനായി കേരള സംസ്ഥാന തീരദേശ വികസന കോർപ്പറേഷൻ തയ്യാറാക്കി പ്രധാനമന്ത്രി മത്സ്യ സമ്പദ യോജന (പി.എം.എം.എസ്.വൈ.) പദ്ധതിയിൽ ഉൾപ്പെടുത്തി കേന്ദ്ര സർക്കാരിന് സമർപ്പിച്ചിട്ടുള്ള 145.87 കോടി രൂപയുടെ മോഡേൺ ഇന്റഗ്രേറ്റഡ് ഫിഷ് ലാന്റിംഗ് ഫെസിലിറ്റിസ് ഇൻ ദി വൈപ്പിൻ-മുനമ്പം കോസ്റ്റൽ സ്റ്റേച്ച് ഓഫ് എറണാകുളം ഡിസ്ട്രിക് പദ്ധതിക്ക് എന്നത്തേക്ക് അംഗീകാരം ലഭ്യമാകുമെന്ന് വ്യക്തമാക്കാമോ;	(എ)	Modern Integrated Fish Landing Facilities in the Vypin- Munambam Coastal Stretch of Ernakulam District പദ്ധതിക്കായി 145.87 കോടി രൂപയുടെ പദ്ധതി രൂപരേഖ കേരള സംസ്ഥാന തീരദേശ വികസന കോർപ്പറേഷൻ തയ്യാറാക്കിയിരുന്നു. പ്രസ്തുത പദ്ധതി പ്രധാനമന്ത്രി മത്സ്യ സമ്പദാ യോജന (PMMSY)-യിൽ ഉൾപ്പെടുത്തി നടപ്പാക്കുന്നതിനുള്ള അനുമതിക്കായി 12.01.2024 തീയതിയിലെ ബി1/356/2023 മത്സ്യ നമ്പർ കത്ത് പ്രകാരം കേന്ദ്ര സർക്കാരിന് സമർപ്പിച്ചിട്ടുണ്ട്. പദ്ധതിക്ക് ഇത് വരെയായി കേന്ദ്രസർക്കാരിന്റെ അംഗീകാരം ലഭിച്ചിട്ടില്ല.
(ബി)	കടൽ ഭിത്തികൾ ഇല്ലാത്തതിനാൽ വർഷം തോറും വർദ്ധിച്ചുവരുന്ന കടലാക്രമണ ഭീഷണിമൂലം ദുരിതമനുഭവിക്കുന്ന വൈപ്പിൻ ജനതയുടെ പ്രയാസങ്ങൾ കണക്കിലെടുത്ത് പ്രസ്തുത പദ്ധതിക്ക് അടിയന്തര അംഗീകാരം ലഭ്യമാക്കാൻ നടപടി സ്വീകരിക്കുമോ;	(ബി)	Modern Integrated Fish Landing Facilities in the Vypin- Munambam Coastal Stretch of Ernakulam District പദ്ധതിക്കായി 145.87 കോടി രൂപയുടെ പദ്ധതി രൂപരേഖ കേരള സംസ്ഥാന തീരദേശ വികസന കോർപ്പറേഷൻ തയ്യാറാക്കിയിരുന്നു. പ്രസ്തുത പദ്ധതി പ്രധാനമന്ത്രി മത്സ്യ സമ്പദാ യോജന (PMMSY)-യിൽ ഉൾപ്പെടുത്തി നടപ്പാക്കുന്നതിനുള്ള അനുമതിക്കായി 12.01.2024 തീയതിയിലെ ബി1/356/2023 മത്സ്യ നമ്പർ കത്ത് പ്രകാരം കേന്ദ്ര സർക്കാരിന് സമർപ്പിച്ചിട്ടുണ്ട്. പദ്ധതിക്ക് ഇത് വരെയായി കേന്ദ്രസർക്കാരിന്റെ അംഗീകാരം ലഭിച്ചിട്ടില്ല.
(സി)	പ്രസ്തുത പദ്ധതിയുടെ പകർപ്പ് ലഭ്യമാക്കാമോ?	(സി)	പദ്ധതി രൂപരേഖയുടെ പകർപ്പ് അനുബന്ധമായി ചേർക്കുന്നു.

സെക്ഷൻ ഓഫീസർ

MODERN INTEGRATED FISH LANDING FACILITIES IN THE VYPIN-MUNAMBAM COASTAL STRETCH OF ERNAKULAM DISTRICT

Submitted to :
Department of Fisheries, Government of India

Submitted Under:
Pradhan Mantri Matsya Sampada Yojana (PMMSY)

KSCADC

December, 2023

MODERN INTEGRATED FISH LANDING FACILITIES IN THE VYPIN-MUNAMBAM COASTAL STRETCH OF ERNAKULAM DISTRICT

Submitted to

Department of Fisheries
Government of India

Under
Pradhan Mantri Matsya Sampada Yojana (PMMSY)

Kerala State Coastal Area Development Corporation Ltd
Department of Fisheries, Government of Kerala

DECEMBER 2023

TABLE OF CONTENT

CHAPTER 1. PREFACE

Foreseeing the immense potential for development of fisheries and for providing focused attention to the sector, the Government of India in May, 2020 approved the "Pradhan Mantri Matsya Sampada Yojana (PMMSY) – A scheme to bring about Blue Revolution through sustainable and responsible development of fisheries sector in India" with an estimated investment of Rs. 20050 crores comprising of (i) Central share of Rs. 9407 crores, (ii) State share of Rs 4880 crores and (iii) Beneficiaries contribution of Rs. 5763 crores for its implementation for a period of 5 years from FY 2020-21 to FY 2024-25 in all States/Union Territories (Figure-1).

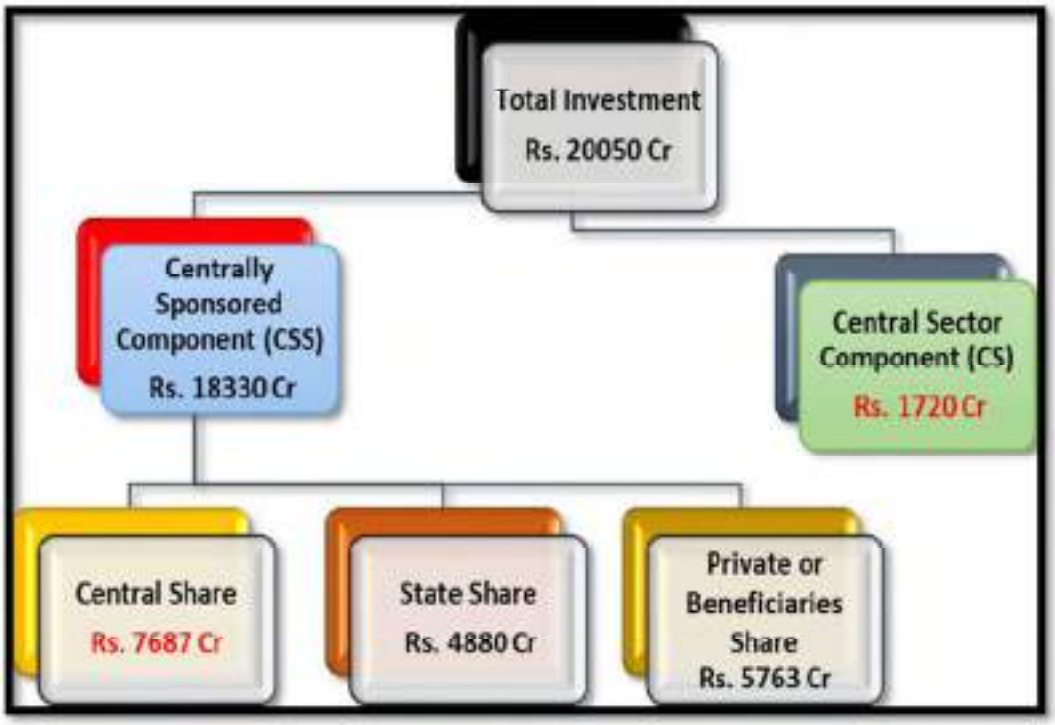


Figure 1. Implementation Schedule - 5 years (2020-21 to 2024-25)

The vision of the project is "Ecologically healthy, economically viable and socially inclusive fisheries sector that contributes towards economic prosperity and well-being of fishers, and fish farmers and other stakeholders, food and

nutritional security of the country in a sustainable and responsible manner".

The Aims and Objectives of the Pradhan Mantri Matsya Sampada Yojana (PMMSY) are:

(a) Harnessing of fisheries potential in a sustainable, responsible, inclusive and equitable manner
(b) Enhancing of fish production and productivity through expansion, intensification, diversification and productive utilization of land and water
(c) Modernizing and strengthening of value chain - post-harvest management and quality improvement
(d) Doubling fishers and fish farmers' incomes and generation of employment
(e) Enhancing contribution to Agriculture GVA and exports
(f) Social, physical and economic security for fishers and fish farmers
(g) Robust fisheries management and regulatory framework

The intended beneficiaries of the PMMSY Scheme are :-

- Fishers
- Fish farmers
- Fish workers and Fish vendors
- Fisheries Development corporations
- Self Help Groups (SHGs)/Joint Liability Groups (JLGs) in fisheries sector
- Fisheries cooperatives
- Fisheries Federations
- Entrepreneurs and private firms
- Fish Farmers Producer Organizations/Companies (FFPOs/Cs)
- SCs/STs/Women/Differently abled persons
- State Governments/UTs and their entities including
- State Fisheries Development Boards (SFDB)
- Central Government and its entities

Targets of PMMSY:-

- **Fish Production and Productivity**

- Increasing fish production to 22 million metric tons by 2024-25 from 13.75 million metric tons in 2018-19.
- Enhancing aquaculture productivity to 5 tons per hectare from the current national average of 3 tons.
- Augmenting domestic fish consumption from 5 kg to 12 kg per capita.

- **Economic Value Addition**

- Increasing contribution of fisheries sector to the Agriculture GVA to about 9% by 2024-25 from 7.28% in 2018-19.
- Doubling export earnings to Rs.1,00,000 crores by 2024-25 from Rs.46,589 crores in 2018-19.
- Facilitating private investment and growth of entrepreneurship in the fisheries sector.
- Reduction of post-harvest losses from the reported 20-25% to about 10%.

- **Enhancing Income and Employment Generation**

- Generating 55 lakh direct and indirect employment opportunities along the value chain.
- Doubling the incomes of fishers and fish farmers.

The project for “Construction of Fish Landing Centres in the Vypin- Munambam Coastal Stretch of Ernakulam district”, is proposed under “Pradhan Mantri Matsya Sampada Yojana (PMMSY) scheme.

The proposal envisages in Construction of Modern Integrated Fish Landing Facilities in the Vypin Munambam stretch of Ernakulam district. The proposal is suggested under “Non- Beneficiary Oriented Activities under Centrally Sponsored Components of Pradhan Mantri Matsya Sampada Yojana, B. Infrastructure and Post Harvest Management, 3. Development of Fishing Harbours and Fish Landing Centres 3.3. Modern Integrated Fish Landing Centres. of PMMSY scheme.

CHAPTER 2. SALIENT FEATURES

1	Title	Construction of Fish landing Centres in the Vypin-Munambam coastal stretch of Ernakulam district.
2	Implementing Agency	Department of Fisheries, Government of Kerala
3	Construction Agency	Kerala State Coastal Area Development Corporation Limited- Accredited Govt Agency
4	Unit Cost	Rs. 25.00 Crore (5 units), Rs.20.87 Crore (1 unit)
5	No of units	6
6	Total Project Cost	**Rs. 145.87 Crore**
7	Pattern of Assistance	**60% CSS : 40 % State**
	Central Share	**Rs. 87.522 Crore**
	State Share	**Rs. 58.348 Crore**
8	Project Duration	24 Months
9	Project Location	Ernakulam district
	Block Panchayat	Vypin
	Taluk	Kochi
	State	Kerala
10	DPR prepared by	Kerala State Coastal Area Development Corporation Limited
11	Nature of the Project	Fish Landing Centre & coastal protection
12	Details of project risks	Climatic Issues Cash Flow Issues Schedule of rates Revision Seabed level variation during execution Stoppage of work in monsoon Natural hazards Unexpected technical issues
13	Details of project management organization strategy	Estimation, Technical Sanction, Tendering and Agreement Execution will be done by KSCADC Price software is the tool for preparing,

		scrutinizing and transmitting the estimates Tendering will be done by inviting online e-tenders from pre-qualified contractors. MS project is the tool used for scheduling the projects Work execution and preparation of bills will be done through Assistant Executive Engineer and Assistant Engineer, other experienced site supervisors and will be passed by Executive Engineer and will be counter Signed by Chief Engineer Passed bills will be submitted to funding agency for release of funds
14	Details of Contract Management	The Public Works manual approved by the state government specifies the duties, responsibilities and delegated powers of officers in contract management. It also specifies fines for project delays and incentives for early completion.
15	Details of Project Implementation Schedule	Details given in DPR
16	Details of Statutory Clearances	CRZ Clearance- Permitted Activity
17	Quality Control infrastructure and mechanism	KSCADC will ensure quality through government approved laboratories and through National Institutes like IIT, Madras, NIOT etc
18	Operation & Maintenance (O&M) arrangements of the project after completion	Maintenance will be required once in 10 years only. This will be entrusted with the custodian
19	Whether detailed estimate attached and plans attached	Yes

CHAPTER 3. EXECUTIVE SUMMARY

The "Modern Integrated Fish Landing Facilities in the Vypin Munambam Coastal Stretch" project is an ambitious initiative aimed at enhancing the fishing infrastructure and livelihoods of the fishing community in the Vypin Munambam coastal area. The Vypin Munambam coastal stretch in Ernakulam district is home to a vibrant fishing community. However, the existing beach landing method poses significant risks to the safety of fishermen and the quality of the catch. Additionally, the absence of proper auction facilities hampers the marketing and sale of the catch, leading to potential financial losses for the fishing community. This project aims to address these critical issues and promote safer, more sustainable, and economically viable fishing practices in the region. The primary objective of the project is to provide safer fish landing facilities. This involves the construction of landing centres and related infrastructure to facilitate the landing of fishing boats and the transfer of catch without the risks associated with beach landings.

Shoreline changes induced by erosion and accretion are natural processes that take place over a range of time scales. They may occur in response to smaller-scale (short-term) events, such as storms, regular wave action, tides and winds, or in response to large-scale (long-term) events such as glaciation or organic cycles that may significantly alter sea levels (rise/fall) and tectonic activities that cause coastal land subsidence or emergence. Hence, most coastlines are naturally dynamic, and cycles of erosion are often an important feature of their ecological character. Wind, waves and currents are natural forces that easily move the unconsolidated sand and soils in the coastal area, resulting in rapid changes of the shoreline. Human activities along the coast (land reclamation, port development, shrimp farming), within river catchments and watersheds (river damming and diversion) and offshore (dredging, sand mining) in combination with these natural forces often exacerbate coastal erosion in

many places and jeopardize opportunities for coasts to fulfill their socio-economic and ecological roles in the long term at a reasonable societal cost.

The 24 km long stretch from Vypin to Munambam is continuously prone to severe sea erosion. The coastal stretch includes potential sites for fishing. Due to the continuous eroding of beach, the fishermen's operational man-days have considerably reduced plunging them into poverty. The major portion of the seawall existing in the proposed coastal stretch requires repair and maintenance which will be undertaken by Irrigation Department. Considering the situation, it is high time to create a holistic development approach for stabilizing the entire 24 km coastal stretch from Vypin to Munambam to enhance the fishing activities of the entire coastal stretch.

Kerala State Coastal Area Development Corporation Limited (KSCADC) and Department of Ocean Engineering, IIT Madras has conducted a systematic investigation on the stability of defined shoreline along the Vypin coastal stretches, north of Cochin Port entrance in the Ernakulam district with specific reference to shoreline erosion. The study shows that some area where fishing is a major activity requires reclamation of beach area, other area which is more of tourism friendly requires a stabilized beach, some areas where the inhabitants are more in numbers requires protection from severe huge attacks

Considering the comprehensive requirement of the whole proposed stretch, it is proposed to construct fish landing facilities which includes Auction hall, sea wall strengthening, yard lighting, toilet block, drainage etc. The proposal also includes installation of offshore breakwater using geotubes in selected sites and groynes in other sites. This project proposal is mainly intended to enhance the fishing activity of the Vypin Munambam stretch and also to manage coastal erosion problems and to restore coastal capacity to accommodate short-and long-term changes induced by human activities, extreme events and sea level rise from Vypin to Munambam area in Ernakulam district.

The major types of works involved are:-

- Valappu beach- 6 submerged geotubes of 3 m dia of 820 m length at a distance of 1600 m from shore, Auction hall of 28.3 m x 6.4 m, Toilet block of 12.5 m x 5.1 m, Seawall strengthening, parking area.
- Malipuram beach- installation of 4 groynes (both T groyne and straight groyne), Auction hall of 28.3 m x 6.4 m, Toilet block of 12.5 m x 5.1 m, parking area.
- Valiyathanparambu – installation of 2 groynes (1 new and 1extension), Auction hall of 28.3 m x 6.4 m, Toilet block of 12.5 m x 5.1 m, parking area.
- Puthenkadappuram – Groynes of length 180 m and 150 m, Auction hall of 28.3 m x 6.4 m, Toilet block of 12.5 m x 5.1 m, Seawall strengthening, parking area.
- Pazhangadu- Groynes of length 180m x 140 m.
- Saidh Mohammed beach- Groynes of length 160 m and 120 m, Auction hall of 28.3 m x 6.4 m, Toilet block of 12.5 m x 5.1 m, Seawall strengthening, parking area.

The unit cost of five proposed Fish Landing Facilities are Rs 25.00 Crore and one landing facilityis Rs. 20.87 Crore. The total project cost comes to Rs 145.87 crores (Rupees One hundred and forty five crore and eighty seven lakh only).

The total amount of **Rs. 145.87 Crore (Rupees One hundred and forty five crore and eighty seven lakh only)** required for " "Modern Integrated Fish Landing Facilities in the coastal stretch of Vypin to Munambam in Ernakulam district" is proposed under PMMSY scheme, Government of India. The proposal is suggested to be implemented under "Non- Beneficiary Oriented Activities under Centrally Sponsored Components of Pradhan Mantri Matsya Sampada Yojana, B. Infrastructure and Post Harvest Management, 3. Development of Fishing Harbours and Fish Landing Centres 3.3. Modern Integrated Fish Landing Centres. 60% of the project cost ie. Rs. 87.522 crore shall be met as PMMSY share and balance 40% ie. Rs. 58.348 Crore as State share.

The "Modern Integrated Fish Landing Facilities in the Vypin Munambam Coastal Stretch" project offers a range of benefits that extend to the local fishing community, the environment, and the regional economy. Enhancement of Fishing activity, environmental protection including protection of the shoreline of Ernakulam district stretching between Vypin to Munambam, prevention of calamities and loss of life, prevention of recurring costs for rehabilitation and compensations, and employment opportunities to the coastal areas in addition to direct revenue generation for the Government.

The project will be implemented within a period of two years.

CHAPTER 4. PROJECT BACKGROUND

4.1. PROJECT INTRODUCTION

Fishing and fisheries are an important part of Kerala's social and economic heritage. This is a sector that augments nutrition and helps generate employment and revenue. India is the third largest fish producing country in the world and accounts for 7.96 per cent of global production. The sector has been one of the major contributors of foreign exchange earnings, with India being one of the leading seafood exporting nations in the world. The export of marine products stood at 13.69 lakh MT with a value of Rs. 57,586.5 crore in 2021-22 (Marine Products Export Development Agency). India is also a major producer of fish through aquaculture and ranks second in the world after China.

The fisheries sector plays an important role in the economy of the State. The share of fisheries sector in the total Gross State Value Added (GSVA at constant price) in 2021-22 constitutes 0.97 per cent and accounts for 0.84 per cent of Gross State Domestic Product (GSDP). Fisheries and aquaculture contributes 10.92 per cent of the GSVA (constant prices 2021-22 (Q)) from the Agriculture and allied sectors.

Kerala with a coastline over 590 km., and an Exclusive Economic Zone (EEZ) of 2.18 lakh Sq km have a significant marine fisheries sector that has long been an important source of occupation and livelihood for the coastal population in the State. The marine population in Kerala is estimated to be approximately 8.08 lakh in 222 coastal villages spread along the nine coastal districts of Kerala. The number of inland fishing villages is 113 and the fishermen population is 2.41 lakh.

Fish production in India in 2020-21 is estimated at 147.3 lakh MT with a contribution of 112.5 lakh MT from inland sector and 34.8 lakh MT from marine sector (Annual report 2021-22, Department of fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India). In 2021-22, Kerala recorded an inland fish production of 2.25 lakh tonnes and the contribution from

the marine sector was 6.01 lakh tonnes. The high value species among the fish catches are still few and prominent among them are seer fish, prawns, ribbon fish and mackerel. Due to climate change and anthropogenic activities such as juvenile fishing, overfishing and unscientific fishing, the catch of marine fisheries showed a declining trend in the last decade. But the timely amendment of the Kerala Marine Fishing Regulation Act (KMFRA), introduction of KMFR Rule and its strict enforcement led to an increase of 26 per cent in marine capture in 2018- 19. The year 2021-22, has registered an increase in marine fish production compared to that of the production obtained during 2019-20 and 2020-21, which demonstrates the revival in the sector and increase in man-days. The inland fish production also increased in 2021-22 due to the introduction of diversified and innovative fish farming practices, across the State

The fishermen population of Kerala is well known for their fishing skills. They have proved their expertise not only in the shallow coastal water fishing but also in deep sea fishing. They venture out from Gujarat coast in the west to Andaman islands in the east. Their skills at launching boats, competence in preparing and handling the nets and other equipments; endurance to with stand the rough sea; knowledge about weather, currents, winds and stars are far superior to fishermen of other state. Hence the contribution of fishermen to the State exchequer is quite significant.

Though the fishermen render significant contribution to the total fish production of Kerala, they remain socially and economically backward. The main stream society has made rapid socio-economic strides in the past sixty years. It's quite an irony that the fishermen who had played a significant role in State's development remained elusive of the general economic prosperity. Lack of proper infrastructure facilities is one of the reasons for their backwardness.

4.1. 1. Fisheries Infrastructure in Kerala

Majority of the fish landings of the State are confined to the existing 25 fishing harbours and more than 220 fish landing centres distributed over 222 fishing villages of the State. These centers are a set of facilities required between

the capture of fish and its consumption. Depending upon the variety and extent of facilities for cleaning, sorting, storage and selling, handling and packing, distribution and maintenance facilities, they may be classified either a fishing harbour or landing centre. Fish landing centre is the backbone of fishery industry of any country. The very existence of the industry depends upon the features of this component. List of Fishing Harbours and Fish Landing Centres are given in Table 1 & Table 2.

Table.1. List of Fishing Harbours in Kerala

Sl No	District	Fishing Harbour
1	Thiruvananthapuram	1. Vizhinjam 2. Muthalapozhy
2	Kollam	1. Thankassery 2. Neendakara
3	Alappuzha	1. Kayamkulam 2. Thottapally 3. Chethy (I&II) 4. Arthungal II
4	Ernakulam	1. Chellanam (I&II) 2. Munambam
5	Thrissur	1. Chettuva
6	Malappuram	1. Ponnani 2. Tanur
7	Kozhikkode	1. Beypore 2. Puthiyappa 3. Koyilandi 4. Vellayil 5. Chombal
8	Kannur	1. Kannur 2. Mopla bay 3. Azheekal
9	Kasargode	1. Kasargode 2. Cheruvathur 3. Manjeswaram

Table.2. List of Fish Landing Areas in Kerala

Sl No	District	Fish Landing Centre
1	Trivandrum	1. Kollemkode 2. Paruthiyoor 3. Poovar 4. Karimkulam 5. Kochuthura 6. Puthiyathura 7. Pallom 8. Erayamanthura 9. Chempakaramanthura 10. Adimalathura 11. Vizhinjam 12. Vizhinjam North 13. Kovalam 14. Poonthura 15. Bheemapally 16. Cheriyathura 17. Valiyathura 18. Vettucaud 19. Kochuveli 20. Valiyaveli 21. Pallithura 22. Fathima Thumba 23. St Andrews 24. Puthenthoppe 25. Vettuthura 26. Shanthipuram 27. Maryanad 28. Puthukurichy 29. Muthalapozhy 30. Anjengo 31. Mampally 32. Vettoor 33. Chilakkur 34. Edava

		35.Singarathoppu 36.Thazhampally 37.Odayam 38.Kapil 39.Kananthura 40.Valiyathoppe 41.Kochuthoppe 42.Poonthura
2	Kollam	1. Azheekal 2. Parayakadavu 3. Cheriyazhhekal 4. Vallanathuruthu 5. Ponmana 6. Kovilthottam 7. Puthenthura 8. Neendakara FH 9. Shakthikulangara 10.Valavithoppu 11.Ozhukkuthodu 12.Thankassery FH 13.Wadi 14.Moothakara 15.Jonapuram 16.Quilon Port 17.Pallithoottam 18.Kakkathoppu 19.Eravipuram 20.Kolathumpaddam 21.Mukkom 22.Chillakal 23.Thottupuzhi 24.Parakkada 25.Thanni
3	Alappuzha	1. Chethy 2. Punnapara viyani 3. Alappuzha ESI

		4. Pallithodu 5. Pallithodu Chappa 6. Anthakaranazhy 7. Cheriyassery 8. Arattuvazhi 9. Polackal 10. Thaikal beach 11. Arthungal 12. Chenna vally 13. Pollathai 14. Vadakkal 15. Paravoor 16. Valiazheekal 17. Thrikunnapuzha 18. Viyani 19. Valanjavazhy 20. Komana FLC 21. Thottapally 22. Pallana HS FLC
4	Ernakulam	1. Murikkam Padam 2. Kalamukku FLC 3. Kalamukku pvt 4. Gosreepuram FLC 5. Puthuvypeen FLC 6. Mulippuram Chappa 7. Ayyampilli beach 8. Kuzhipilli beach 9. Puthankadappuram 10. Munambam FH 11. Munambam Mini 12. Kunji Thai 13. Ezhikkara 14. Chathanad 15. Thoppumpady 16. Gondu Parambu 17. Tholekkadavu

		18.Cheriyakadavu 19.Kannamaly 20.Puthenthodu 21.Chellanam FH 22.Cherai Beach 23.Edavanakkadu 24.Beach Road
5	Thrissur	1. Azhikode 2. Munnakal 3. Eriyad 4. Kara 5. Kathiyalam 6. Attupuram 7. Perinjanam 8. Arattukadavu 9. Vanchipura 10.Companykadavu 11.Chamakal 12.12. Palapetty 13.Kazhimbram 14. Nattika beach 15.Nambikadavu 16.Vadanapally 17.Chettuva 18.Munakkadavu 19.Blangad 20.Puthen Kadappuram 21.Edakazhiyoor 22.Panchavadi 23.Manthalamkunnu
6	Malappuram	1. Palapetty 2. Veliyamkodu 3. Ponnani 4. Koottayi 5. Thekkekoottayi 6. Pallivalappu

		7. Vakkad 8. Puthengaadu 9. Thevar 10. Tanur 11. Farukhpalli 12. Parappanangadi 13. Alungal beach 14. Vallikunnu/Angadi 15. Kadalundi
7	Kozhikkode	1. Chaliyam 2. Beypore 3. Kozhikkode South 4. Chombala 5. Badagara 6. Badagara, Azhithala 7. Kolavi (Iringal) 8. Thikkodi (Kodikkal) 9. Valavi Kadappuram 10. Muthayakadappuram 11. Moodadi 12. Koloth 13. Quilandy/ Koloth 14. Kovalad 15. Pollikaavu 16. Kappad 17. Edakadavu 18. Elathur 19. Puthiyappa 20. Vellayil
8	Kannur	1. Edakkad 2. Gopalpatai 3. Thalayikunhi 4. New Mahe 5. Dharmadam FC 6. Terminal 7. Ettikulam

		8. Azheekal Jetty 9. Tellichery 10. Ayikkara 11. Azhikkode South 12. Muzhapilangad 13. Palakode
9	Kasargode	1. Pallikara 2. Chittari 3. Kottikulam 4. Bekal 5. Kizhur 6. Kizhur Harbour 7. Talangara jetty 8. Kasaba 9. Adakathbayal 10. Mogral 11. Koippadi 12. Uppala 13. Arikkadi 14. Hosabettu 15. Kunzhathur 16. Ajanoor- N-Bella 17. Chittari 18. Hosdurga-S-Bella 19. Thaikadappuram **20.** Poonchavikadappuram

With regard to the harbours and landing places for fishing vessels,

- **Article 6.17 of the FAO Code of Conduct for Responsible Fisheries** states that "States should ensure that fishing facilities and equipment as well as all fisheries activities allow for safe, healthy and fair working and living conditions and meet internationally agreed standards adopted by relevant international organizations."

- **Article 8.9 of the FAO Code of Conduct for Responsible Fisheries** refers to Fishing Operations and it states that Concerned States should take into account, inter alia, the following in the design and construction of harbours and landing places:

a) Safe havens for fishing vessels and adequate servicing facilities for vessels, vendors and buyers are provided.

b) Adequate freshwater supplies and sanitation arrangements should be provided.

c) Waste disposal systems should be introduced, including for the disposal of oil, oily water and fishing gear.

d) Pollution from fisheries activities and external sources should be minimized.

e) Arrangements should be made to combat the effects of erosion and siltation.

4.1.2. Resource Potential

Kerala is one of the active maritime states in India. Kerala rank second in marine fish production of India, around 3.91 lakh MTs in the year 2020-21 and earned an income of 7673.58 crores. Around 3.24 lakh people are directly involving the marine fishing activity contributing 21% to the total annual production. It makes a significant contribution to the National Income through export of marine products.

According to the available estimates of potential fishery resources of the West coast, particularly in the south west coasts, Kerala possess the richest fishing grounds in the region. The latest picture regarding the exploitable marine resources of Kerala coast is the one furnished by the Expert Committee on Marine Fisheries in Kerala, 1989, headed by AG.Kalawar.

Table.3. Resources in Tonnes

Stock	Depth Zones			
	0-20 m	21-80 m	81-200 m	Total
Dermersal	37,935 (26.1%)	90,432 (62.2%)	17,040 (11.7%)	1,45,407 (100%)
Pelagic	3,07,539 (26.1%)	7,32,908 (62.2%)	1,37,863 (11.7%)	11,78,310 (100%)
Total	**3,45,490**	**8,23,252**	**1,54,875**	**13,23,717**

Table.4. Maximum Sustainable Yield

MSY	Depth Zones			
	0-20 m	21-80 m	81-200 m	Total
Dermersal (60%)	22,761 (26.1%)	54,249 (62.2%)	10,224 (11.7%)	87,344 (100%)
Pelagic (60%)	1,84,786 (26.1%)	4,40,349 (62.2%)	82,831 (11.7%)	7,07,956 (100%)
Total	**2,07,547**	**4,94,608**	**93,055**	**7,95,300**

4.1.3. Marine Fish Production

Fish production in India in 2020-21 is estimated at 147.3 lakh MT with a contribution of 112.5 lakh MT from inland sector and 34.8 lakh MT from marine sector (Annual report 2021-22, Department of fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India). In 2021-22, Kerala recorded an inland fish production of 2.25 lakh tonnes and the contribution from the marine sector was 6.01 lakh tonnes. The high value species among the fish catches are still few and prominent among them are seer fish, prawns, ribbon fish and mackerel. Due to climate change and anthropogenic activities such as juvenile fishing, overfishing and unscientific fishing, the catch of marine fisheries showed a declining trend in the last decade. But the timely amendment of the Kerala Marine Fishing Regulation Act (KMFRA), introduction of KMFR Rule and its strict enforcement led to an increase of 26 per cent in marine capture in 2018-19. The

year 2021-22, has registered an increase in marine fish production compared to that of the production obtained during 2019-20 and 2020-21, which demonstrates the revival in the sector and increase in man-days. The inland fish production also increased in 2021-22 due to the introduction of diversified and innovative fish farming practices, across the State.

The production of most of the marine fishes like elasmobranchii, oil sardine, lesser sardine, anchoviella, saurida, perches, sciaenid's ribbon fish, other carangids, mackerel soles, seer fish, tuna, leiognathids, penaeid prawn, crabs, and cephalopods have shown an increase in 2021-22. The per capita fish consumption of Kerala is 19.4kg per year. Among the union territories the Andaman and Nicobar islands per capita fish consumption is 59.5kg per year (Handbook of Fisheries Statistics, 2020). The species-wise marine fish landings in Kerala from 2018-19 to 2021-22 are given in Table 5.

Table 5. Species-wise composition of Marine fish landings in Kerala (2018-19 to 2021-22) (in Metric Tonnes)

Sl. No	Species	2018-19	2019-20	2020-21	2021-22
1	Elasmobranchs	7645	2764	1753	3596
2	Eels	593	879	860	1099
3	Cat Fish	30	258	34	126
4	Chirocenrtrus	23	108	73	82
5(a)	Oil Sardine	87331	44499	6762	12340
(b)	Lesser Sardine	19337	33199	42525	62042
(c)	Hilsa ilisha	0	0	0	0
(d)	Other Hilsa	0	311	523	93
(e)	Anchovilla	33242	58490	27247	38683
(f)	Trissocles	8444	7377	7510	5654
(g)	Other Clupeids	6177	5804	6479	7049
6(a)	Harpodon nehereus	0	0	0	0
(b)	Saurida & Saurus	14215	17445	14724	20308
7	Hemirhamphus & Belone	9581	739	722	753
8	Flying Fish	3818	8	40	67

9	Perches	34962	40955	47996	71572
10	Red Mullets	463	443	410	1006
11	Polynemides	3925	9	0	2
12	Sciaenides	16519	5406	5830	8396
13	Ribbon fish	10617	5425	1524	9949
14(a)	Caranx	5412	2323	1695	1454
(b)	Chorinemus	1427	268	277	519
(c)	Thachynotus	1814	11	87	6
(d)	Other Carangids	56389	37775	53118	83392
(e)	Coryphaena	881	1046	1074	1856
(f)	Elacate	16	287	33	173
15(a)	Leiognathus	1761	2942	2058	2344
(b)	Gazza	233	0	1	19
16	Lactrious	246	839	903	1081
17	Pomfrets	4624	2147	6482	2758
18	Mackerel	127419	35894	60592	63587
19	Seer fish	6230	4329	3806	6176
20	Tunnas	29810	16793	13197	23067
21	Sphyraena	3131	3480	5040	7120
22	Mugil	25	55	16	31
23	Bregmaceros	0	0	0	0
24	Soles	8547	14197	6245	12100
25(a)	Penaeid Prawn	52331	39905	33524	54868
(b)	Non Penaeid Prawn	8613	2515	2187	2825
(c)	Lobsters	172	41	48	101
(d)	Crabs	2777	5080	4087	6145
(e)	Stomatopods	0	488	12	158
26	Cephalopods	30679	35686	19786	42716
27	Miscellaneous	10271	45148	12403	45489
	Total	**609730**	**475368**	**391683**	**600802**

Table 6. Fish Production in Kerala& India (2016-17 to 2021-22) (lakh tonnes)

Year	Kerala			All India		
	Marine (Provisional)	Inland	Total	Marine	Inland	Total
2016-17	4.66	1.66	6.76	56.25	78.06	114.31
2017-18	4.84	1.89	6.73	56.68	89.02	125.9
2018-19	6.1	1.92	8.02	58.53	97.2	135.73
2019-20	4.73	2.05	6.8	37.27	104.37	141.64
2020-21	3.9	2.05	5.95	34.8	112.5	147.3
2021-22	6.01	2.25	8.26	Not available		

Source: Annual report 2021-22, Department of fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India and Department of Fisheries, Government of

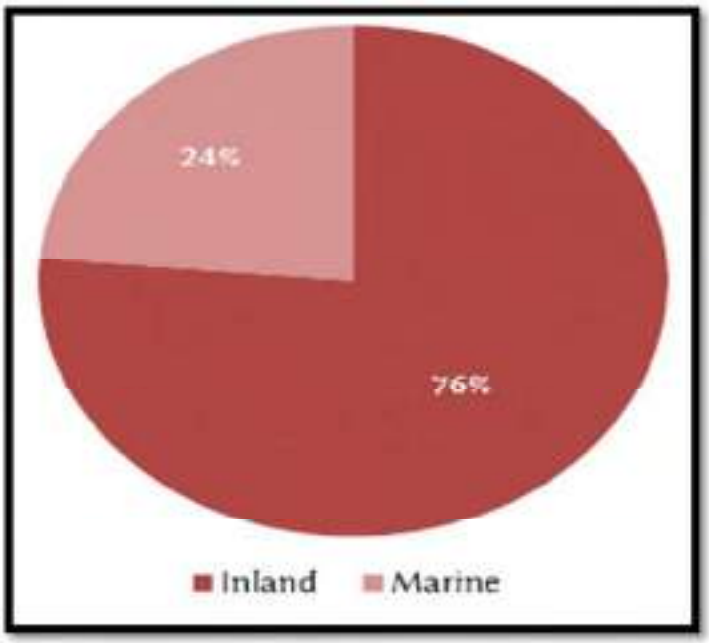


Figure 2. Fish production in India (2020-21)

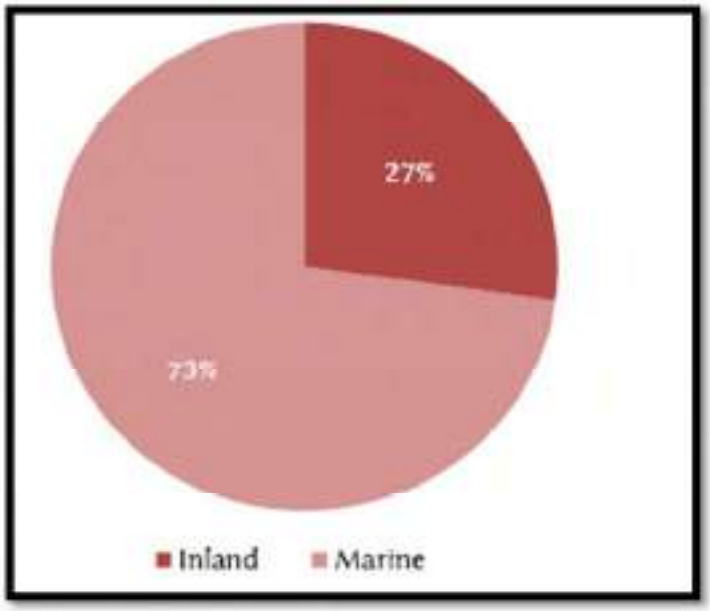


Figure 3. Fish production in Kerala (2021-22)

District-wise fish production in Kerala is given in Table 7.

Table 7. District wise fish production in Kerala 2021-22 (lakh tonnes)

District	Marine Fish Production	Inland Fish Production	Total Fish Production
Thiruvananthapuram	0.58	0.022	0.6
Kollam	1.11	0.11	1.22
Alappuzha	0.33	0.43	0.76
Pathanamthitta	NA	0.04	0.04
Kottayam	NA	0.56	0.56
Ernakulam	**2.04**	**0.39**	**2.43**
Idukki	NA	0.015	0.02
Thrissur	0.33	0.13	0.46
Palakkad	NA	0.05	0.05
Malappuram	0.33	0.04	0.37
Kozhikkode	0.925	0.024	0.95
Wayanad	NA	0.012	0.01
Kannur	0.16	0.04	0.2
Kasargode	0.2	0.39	0.59

State(Kerala)	6.01	2.25	8.26
Source: Directorate of Fisheries			

Kerala has made vital contributions to export of marine products the country. In 2021-22, export of marine products from Kerala was 1.8 lakh tonnes valued at Rs.6,396.2 crore. It accounts for 13.2 per cent in terms of quantity and 11.1 per cent in terms of value of the marine products export from India. Details are provided in Table 8.

Table 8. Export of Marine Products from India and Kerala(Q: Quantity in Metric Tonnes V: Value - Rs. in crore)

Year		India	Kerala	% share of Kerala
2013-14	Q	983756	165698	16.84
	V	30213.26	4706.36	15.58
2014-15	Q	1051243	166754	15.86
	V	33441.61	5166.08	15.45
2015-16	Q	945892	149138	15.77
	V	30420.82	4644.42	15.27
2016-17	Q	1134948	159141	14.02
	V	37870.9	5008.54	13.23
2017-18	Q	1377244	178646	12.97
	V	45106.89	5919.03	13.12
2018-19	Q	1392559	183064	13.15
	V	46589.37	6014.7	12.91
2019-20	Q	1289651	148227	11.49
	V	46662	5020.34	10.76
2020-21	Q	1149510	144700	12.59
	V	4372098	5039.29	11.53
2021-22	Q	1369264	180315	13.2
	V	57586.5	6396.2	11.1
Source : MPEDA				

4.1.4. Mechanized Fishing

Kerala's prominence in the field of mechanized fishing is indeed noteworthy. The state has been a pioneer in adopting and promoting mechanized fishing techniques, thanks in part to various development schemes introduced under the Indo-Norwegian Project during the 1960s. This project brought modern fishing technologies and practices to the region, significantly enhancing the fisheries industry in Kerala.

Mechanized fishing in Kerala involves several methods and types of gear, including trawling, gill netting, hooks and lines, purse seining, and more.

1. **Trawling:** Trawling is a fishing method that involves dragging a net through the water behind a boat. In Kerala, mechanized trawling is typically carried out using boats that are around 12 to 20 meters in length. This method is effective for catching a variety of fish species, including those that live closer to the seabed.
2. **Gill Netting**: Gill netting is another common mechanized fishing method in Kerala. Smaller fiberglass-reinforced plastic (FRP) vessels, usually around 8 meters in size, are often used for gill netting. Gill nets are vertical panels of netting designed to entangle fish by their gills as they swim into the net.
3. **Hooks and Lines**: This method involves using fishing hooks, lines, and sometimes baits to catch fish. While it's not as mechanized as trawling or gill netting, it is still a popular and effective method for catching specific fish species, especially those that are closer to the surface.
4. **Purse Seining**: Purse seining is a fishing method that involves surrounding a school of fish with a large net and then "pursing" the net at the bottom to enclose the fish. This method is used to catch fish that tend to school together, such as sardines and mackerel.

Kerala's success in mechanized fishing has had a significant impact on the state's economy and the livelihoods of its coastal communities. The development schemes and the introduction of modern technologies have enabled Kerala's fishermen to increase their catch and improve their standard of living. This

pioneering effort in mechanized fishing has contributed to the state's status as a leader in India's fisheries industry.

4.1.5. Artisanal Fishing

Artisanal fishing in Kerala is an integral part of the state's coastal communities, culture, and economy. It is estimated that there are approximately 25,000 such vessels in operation along its coast. These traditional craft come in various types, each suited to specific fishing practices. Some of the common types of traditional fishing craft in Kerala include:

1. **Dugout Canoes:** Dugout canoes are handcrafted from a single tree trunk. They are typically small and have been used for traditional fishing in Kerala for generations.
2. **Plank-Built Canoes:** Plank-built canoes are constructed using wooden planks, offering more stability and capacity compared to dugout canoes.
3. **Marine Plywood Canoes:** These canoes are made using marine-grade plywood and provide durability and resistance to saltwater.
4. **Catamarans (Cattamaram):** Catamarans are twin-hulled vessels, which provide stability in the water. They are often used for various fishing activities.
5. **Large Kettuvalloms:** Kettuvalloms are traditional houseboats, but some are adapted for fishing. These large vessels, about 20 meters in length, are often fitted with multiple outboard motors (OBMs) with a total power capacity of 25 to 40 horsepower.

The majority of these traditional fishing craft are equipped with Outboard Motors (OBMs), which makes them more efficient and versatile in their fishing operations. OBMs help fishermen reach their fishing grounds quickly and navigate effectively. Common types of fishing gear used with these traditional craft include gill nets, purse seines, and shore seines. Gill nets are vertical panels of netting used to entangle fish, while purse seines involve surrounding a school of fish with a large net and "pursing" it to enclose the catch. Shore seines are used in shallower waters near the coast.

Traditionally, the operations of these craft typically extend up to a range of 20 kilometers off the coast. However, some of the larger kettuvalloms, which are fitted with powerful OBMs, are capable of operating beyond this distance. It's worth noting that traditional, non-motorized craft are also being motorized with the assistance of financial institutions, which helps improve the efficiency and productivity of traditional fishing practices while preserving the cultural heritage of these crafts. This modernization and motorization have significantly impacted the fishing industry in Kerala, allowing fishermen to expand their reach and increase their catch.

4.1.6. Shore Based Facilities

Shore based facilities like ice plant; cold storages etc. are available all along the coastal region. Rigorous fishing activities are already going on in and around the fishing villages of the State. The shore based facilities now available will be capable to take care of the additional landing due to up gradation of the fishery harbour. A well-developed road network connecting the coastal belt and the hinterlands makes the transportation of fish and fish products easier. Railways also play a major role in the transportation of fish products.

The presence of shore-based facilities such as ice plants and cold storages along Kerala's coastal region is essential for the efficient handling and preservation of fish and seafood. These facilities play a vital role in supporting the local fishing industry and contribute to the state's economy.

1. **Ice Plants:** Ice is crucial for preserving the freshness and quality of the catch. Ice plants provide a steady supply of ice to fishermen, enabling them to chill their catch immediately after it is brought ashore. This helps maintain the fish's quality and extends its shelf life.
2. **Cold Storages:** Cold storages are essential for storing fish and seafood at low temperatures to prevent spoilage. These facilities are valuable for fishermen, fishmongers, and exporters, as they allow for the preservation of fish until it is ready for distribution, further processing, or export.

3. **Fishing Villages:** Kerala's coastal fishing villages are hubs of rigorous fishing activity. The presence of shore-based facilities in these areas is essential for handling the significant volume of fish and seafood landed daily by local fishermen.
4. **Fishery Harbours:** Upgrading fishery harbours can lead to increased landing activity. The existing shore-based facilities, including ice plants and cold storages, are expected to handle the additional volume of fish due to these upgrades. This infrastructure is essential to prevent post-harvest losses and ensure the quality of the catch.
5. **Transportation Network:** Kerala benefits from a well-developed road network that connects the coastal regions to the hinterlands. This road network makes it easier to transport fish and fish products from fishing villages to markets, processing facilities, and export hubs.
6. **Railways:** The role of railways in the transportation of fish products is also significant. Rail transport can efficiently move large quantities of seafood over longer distances, allowing for broader distribution and access to markets beyond the immediate coastal region.

The availability of shore-based facilities, a robust transportation network, and railway connectivity are crucial components of the seafood supply chain in Kerala. They support the livelihoods of fishermen, ensure the availability of fresh seafood to consumers, and facilitate the state's participation in the broader seafood industry, including both domestic and international markets. These infrastructure elements are vital in maintaining the quality and value of the seafood industry in Kerala

4.1.7. Fish Marketing

Fish marketing in Kerala is a complex and dynamic process that involves the buying, selling, and distribution of fish and seafood products. The state of Kerala, with its extensive coastline and a population that highly depends on seafood, has a well-established fish marketing system

1. **Fishermen and Catch:** The process begins with fishermen who go out to sea or fish in inland waters to catch a variety of fish and seafood. These fishermen use various traditional and modern fishing methods, including nets, hooks, and lines.
2. **Fish Landing Centers:** Fishermen bring their catch to designated fish landing centers along the coast. These centers serve as key collection points where fish are weighed, sorted, and recorded.
3. **Auction and Sales:** After landing, fish are often auctioned. Fish auction houses or markets are common in fishing communities, where wholesalers, retailers, and exporters participate in bidding for the catch. In addition to auctions, direct sales to buyers, including local consumers, are common.
4. **Wholesalers:** Wholesalers play a crucial role in the distribution chain. They purchase fish in bulk from auctions and landing centers. These wholesalers may sell fish to retailers, processing units, and exporters.
5. **Retailers:** Retailers, such as fishmongers and seafood shops, obtain their supplies from wholesalers. They are responsible for selling fish and seafood products to local consumers. Many of these retailers have shops in local markets and along the coast.
6. **Processing Units:** Kerala also has processing units that prepare fish for export and domestic markets. These units handle tasks like cleaning, filleting, freezing, and packaging. They source fish from various channels, including wholesalers and direct purchases from fishermen.
7. **Export:** Kerala is a significant exporter of seafood products, including shrimp, prawns, and various fish varieties. Exporters procure seafood from different sources, ensure quality standards are met, and distribute products to international markets.
8. **Government Regulation:** The government, through the Fisheries Department and related authorities, regulates fish marketing in Kerala. It enforces standards for fish quality and safety and oversees various aspects of the industry, including licensing and hygiene practices.
9. **Marketing Infrastructure:** Kerala has initiated activities to create network of marketing infrastructure, including fish markets, cold storage facilities, and

transportation networks that connect the coastal regions to the domestic and international markets.

10. **Consumer Market:** Kerala has a strong local demand for fish and seafood, with seafood being a staple in the state's cuisine. Consumers can access fresh seafood from local retailers and markets.
11. **Cooperative Societies:** Many fishermen in Kerala are organized into cooperative societies that facilitate collective marketing, ensuring fair prices for fishermen and efficient distribution of fish.

Fish marketing in Kerala is a vital sector of the state's economy, providing livelihoods for numerous people and serving as an essential source of food. The industry's success depends on maintaining quality, adherence to regulations, and sustainability practices to ensure the long-term viability of Kerala's fishing and seafood industry.

4.1.8. Fishery Development Programmes

The proper planned development of the fishing industry in Kerala involves several essential pre-requisites, including modernization of existing fishing crafts, the introduction of new-generation crafts, improved processing and marketing, and enhanced landing and shore-based facilities. Kerala has made significant progress in these areas in recent years.

Kerala has recognized the importance of infrastructure development for the fishing industry. Fishery harbours, which serve as central hubs for fishing activities, have been a major focus. The state has completed 24 fishery harbor projects, and several more are in progress. These harbours provide essential facilities for the landing, storage, and distribution of fish and seafood products. Adequate berthing and anchoring facilities are crucial for the safe and efficient operation of fishing vessels. Kerala has been investing in improving these facilities to meet the needs of both mechanized and artisanal fishing sectors.

Over the past decades, Kerala has made significant strides in developing its fishing infrastructure as a model to the Government development schemes. . This progress has had a positive impact on the fishing industry, improving the livelihoods of fishermen and contributing to the state's economy. The government of Kerala has a dedicated focus on completing ongoing projects and bringing existing facilities up to international standards. This includes modernizing and expanding infrastructure, enhancing the efficiency of fish landing and handling, and ensuring that facilities meet modern standards for hygiene and safety.

Improving hygienic standards is a critical aspect of the comprehensive approach to fisheries development. Ensuring that fish handling, processing, and storage meet international hygiene standards is vital for product quality and safety. Also Kerala recognizes the importance of post-harvest infrastructure, including cold storage facilities. These facilities help preserve the freshness and quality of fish and seafood, making them available for longer periods and reducing post-harvest losses.

Kerala's comprehensive approach to fisheries development, including infrastructure improvements, hygiene standards, and post-harvest facilities, is a testament to the state's commitment to the fishing industry. These efforts aim to support the livelihoods of fishermen, improve the quality of seafood products, and enhance the industry's contribution to the state's economy. Furthermore, these developments contribute to the sustainability of the fishing sector and its alignment with global standards.

4.1.9. Coastal Erosion in Kerala

With a coastline of over 590 Km, coastal erosion is considered as one of the significant threatening hazards faced by the coastal population of Kerala. The National Centre for Coastal Research (NCCR) has carried out a study on shoreline changes along the mainland of the Indian Coast. About 590 km long shoreline distributed among nine coastal districts and one UT was analyzed by NCCR for the period from 1990-2018 to estimate shoreline changes. The shoreline analysis

suggests that 46% of coast is eroding, 23% is accreting and 31% is in stable state. The details are given in Table 9.

Table 9. Erosion and accretion percentage along Kerala coast

1990-2018	Status	(7 Class) %	Length (in km)	(3Class) %	Length (in km)
Kerala	High Erosion	1	5.53	46	275.33
	Moderate Erosion	2	9.26		
	Low Erosion	44	260.53		
	Stable	31	182.64	31	182.64
	Low Accretion	17	100.69	23	134.99
	Moderate Accretion	3	17.84		
	High Accretion	3	16.45		

The district wise analysis suggests that the Kozhikkode (67.7%) and Alappuzha (54.1%) coasts, erosion exceeds more than 50%, followed by Kollam (49.7%) and Malappuram (49.2%). Thrissur (49.1%) is the only coastal state, which is having more than 40% of accretion, followed by Thiruvananthapuram with 31.2%. Most of the coastal districts of Kerala shows eroding trend for the past 28 years shoreline change analysis. The district wise details of shoreline changes status are given below in Table 10.

Table 10. District wise shoreline changes (in percentage)

Districts	Coastal Length	Erosion	Stable	Accretion
		In %		
Kasargode	83.51	38.8	42.6	18.5
Kannur	69.05	46.4	31.8	21.8
Kozhikkode	78.05	67.7	25.5	6.7
Malappuram	50.86	79.2	32.6	18.2
Thrissur	61.55	31.8	19.1	49.1
Ernakulam	**45.05**	**43.2**	**38.30**	**18.50**
Alappuzha	83.55	54.1	22.70	23.20
Kollam	45.72	49.7	31.90	18.40

Thiruvananthapuram	75.62	34.4	34.4	31.20
Total	**592.96**	**46.4**	**30.80**	**22.80**

Table 11. shows the seven different classes of erosion, accretion and stable in kilometers for all nine coastal districts of Kerala

Table.11. District wise shoreline status of Kerala

Length in km (1990-2018)								
Districts	**Length (in kms)**	**High Erosion**	**Moderate Erosion**	**Low Erosion**	**Stable**	**Low Accretion**	**Moderate Accretion**	**High Accretion**
Kasargode	83.51	0.02	0.14	32.26	35.60	13.25	0.46	1.78
Kannur	69.05	0.05	0.18	31.82	21.97	11.72	2.84	0.46
Kozhikkode	78.05	0.76	0.57	51.53	19.93	4.67	0.34	0.25
Malappuram	50.86	0.12	1.28	23.60	16.58	8.93	0.20	0.14
Thrissur	61.55	0.00	0.41	19.18	11.76	18.23	7.92	4.04
Ernakulam	45.05	0.02	0.26	19.19	17.26	4.93	0.50	2.89
Alappuzha	83.55	2.03	5.29	37.85	18.99	11.79	3.26	4.35
Kollam	45.72	1.91	0.28	20.55	14.57	7.25	0.31	0.85
Thiruvananthapuram	75.62	0.62	0.85	24.55	25.98	19.92	2.01	1.69
Total	**592.96**	5.53	9.26	260.53	182.64	100.69	17.84	16.45
		275.33			**182.64**	**134.99**		

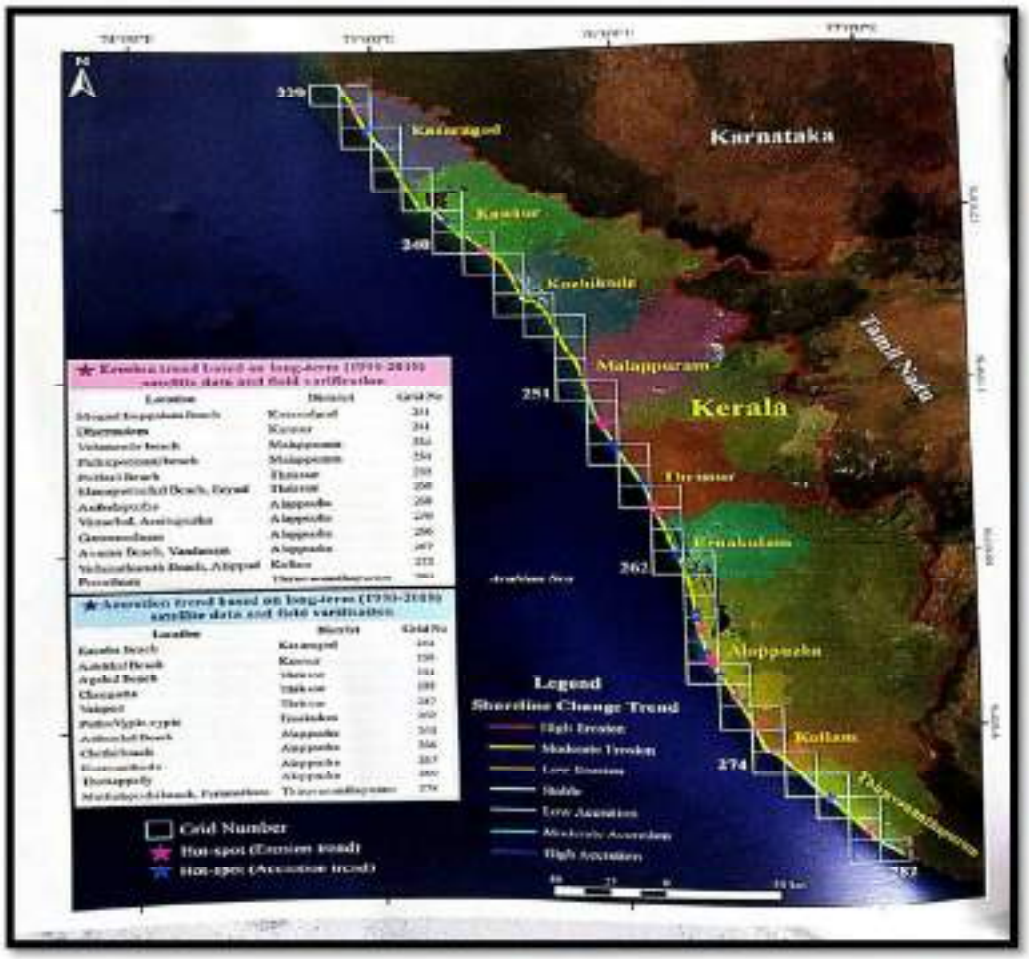


Fig.4. Shoreline Map of Kerala

The coastal stretch of Kerala extends along the southwestern Indian peninsula. It is divided into 9 districts (Thiruvananthapuram, Kollam, Alappuzha, Ernakulam, Thrissur, Malappuram, Kozhikode, Kannur, Kasaragode) along the coast. About 420 km of coastal stretch is protected by hard structures (such as sea walls, groyne field, etc.) (Sundar and Murali, 2007). The region has three distinct seasons, the pre-monsoon from February to May, the southwest monsoon from June-September, and Post monsoon from October to January, annually. The normal tide variation in Kerala is between 0.9 m in the south and 1.8m in the north (Thiruvenkatasamy and Girija, 2014). The net annual longshore sediment transport was reported to vary between 0.32 x 105 m3 and 2.3 x 105 m3 along

the Kerala coast with the net transport direction being pre-dominantly northerly for most locations along with Kerala. The Kerala coast faces high erosion by various natural processes such as wind, currents, and waves, the sediment moves along the shore, which changes the shoreline (Mallik et al., 1987). The longshore currents are predominantly northerly during the fair season, whereas it is mostly towards the south during the monsoon season.

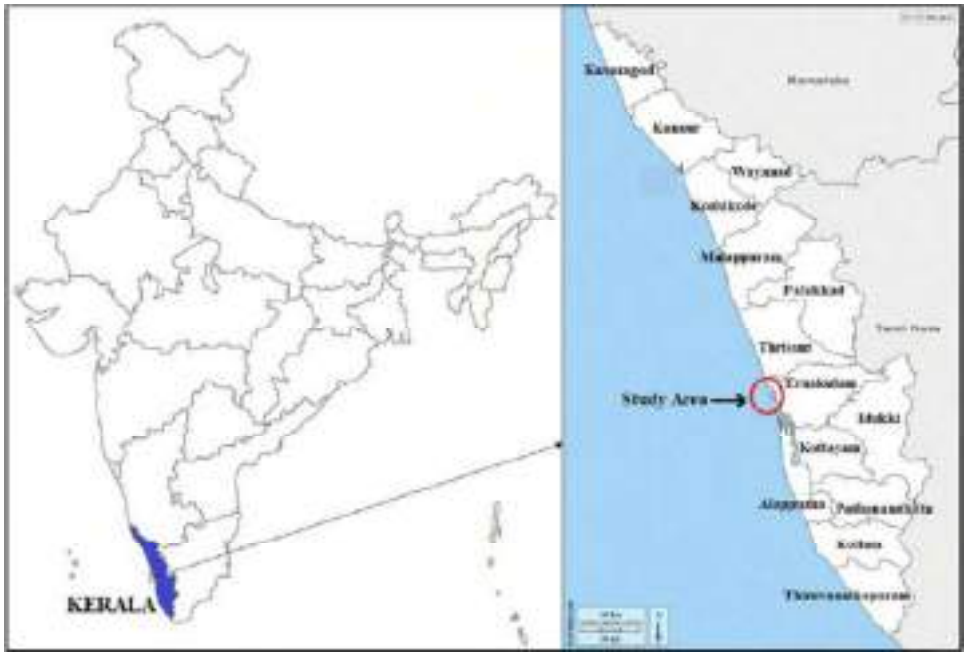


Fig.5. Kerala- Ernakulam district

The Kerala coastal stretch has been traditionally protected by seawalls and is facing a severe threat of coastal erosion owing to the continued intense wave and tide induced forces experienced along the exposed coastal stretches. It is necessary to protect the coastal stretch extending between Vypin and Munambam in order to conserve the flourishing fishing, industrial and tourism activities; in addition to preserving the state highway road which runs parallel to the said coastline.

Kerala State Coastal Area Development Corporation Limited (KSCADC) has entrusted IIT Madras to carry out a systematic investigation on the stability of defined shoreline along the Vypin coast stretches north of Cochin Port entrance in the Ernakulam district with specific reference to shoreline erosion. Accordingly, IIT, Madras has submitted the Technical and commercial proposal for protection of coastal stretch from Vypin to Munambam. The proposal was prepared by IIT, Madras based on:-

- Investigation of shoreline erosion rate along the specified coastal stretch (about 20km long stretch in the Vypin area north of Cochin port entrance) through satellite imageries over the past 2 decades.
- By conducting study on annual wave climate off the Vypin coastal stretches through detailed numerical modelling validated through measurements off Cochin coast
- By conducting Field investigations of shoreline profile, beach profiles, sediment characteristics and littoral current.
- Land Usage- Identification.

The present proposal is prepared based on the model study conducted by IIT, Madras and the secondary datas collected from various agencies of State Government. ***(Model Study Report attached as Annexure 2)***

4.2. PROJECT NEED

4.2.1. The coastal stretch from Vypin to Munambam- Details

Coast line of Ernakulam district is found to be the most vulnerable compared to the other coastal stretches of the state. The aggressive wave climate, steep bed slope where the water depth is up to 6 meters within a distance of 100-120 meters from shore, results in heavy wave breaking close to the shore line. Due to this the conventional shore protection measures like rubble mound sea wall is found to be ineffective. These structures require frequent repairs and strengthening. Apart from this the sea wall itself is found to be a potential source of erosion in many places. Due to inadequate slope of sea wall on the sea side the wave energy is not fully absorbed. This results in the reflection of the incident high waves causing scour at the toe of the sea wall. Between Vypin and Munambam, the sandy beach is negligible in front of the sea wall. Hence heavy wave over topping is observed at many places in the area. This result in severe damages or total collapse of the fishermen houses situated close to the sea wall.

The area from Vypin to Azhimugam in Ernakulam district is one of the areas under extreme threat of sea attack. Due to constant climate change, sea attacks are increasing exponentially in this region. Fishermen living in this area lose their life and property during this time and even their daily work is difficult as they cannot go to the sea. Also the inhabitants are forced to relocate to nearest schools and other public building as their houses gets completely washed away. Earlier 4 groynes were established for coastal protection in this area but many of them have been destroyed due to constant sea attack. With the onset of monsoon season, the sea erosion intensifies, the sea water starts seeping into the houses thus causing the situation worse at these stretches especially in Edavanakkad, Nayarambalam and Veliyathanparambu beaches.

The entire coastal stretch includes potential sites for fishing as well as tourism. Due to the continuous eroding of beach, the fishermen's operational

man-days have considerably reduced plunging them into poverty. The major portion of the seawall existing in the proposed coastal stretch is in dilapidated condition making the situation more worse. Considering the situation, it is high time to create a holistic development approach for stabilizing the entire 24 km coastal stretch from Vypin to Munambam to provide infrastructure facilities for fish landing for enhancing the fishing activities of the area. The existing condition of random study area is depicted below:-

Valappu beach

This stretch extends for 1.5 km and is observed to have a beach width of about 25m and it is located immediately north of the IOCL facilities. The beach slope is found to be very steep and it is understood that the beach width oscillates depending on the wave climate/seasons. The cross-shore sediment transport is found to be significant during south-west monsoon season. Valappu beach is identified to be an active tourist attraction and thus the aesthetics needs to be preserved

Image 1- Valappu beach

Veliyathamparambu beach

The 200m stretch of this beach is located in between two existing groynes designed by IITM. The two groynes (North one constructed as the groyne, whereas the southern groyne has been protruding as an extension of an existing sea wall) have facilitated the formation of a beach width of about 30m wide. The head section of both the groynes is damaged which needs rehabilitation. At present, it is stated by locals that about 50 boats are using this beach as a landing facility and are pleading for its sustainability.

Image 2- Veliyathamparambu beach

Saidh Mohammed beach

This stretch has been protected with a groynes field designed by IITM which has been serving its purpose and has also encouraged the formation of beach on either side of each of the groynes. The beach thus formed has been serving as a buffer against the wave attack in the near shore region. Although, the existing groyne head sections may require strengthening post a detailed inspection of the same.

Image 3- Saidh Mohammed beach

Saidh Mohammed beach 2 (North-Nearby Sudhan mukk)

There is no immediate threat to this section of the coastal stretch, and thus no protection measures need to be commissioned with immediate effect. The coastal stretch of cell 12 includes Saidh Mohammed beach (1) and Saidh Mohammed beach 2 (North-Nearby Sudhan mukk). The erosion and accretion

along the shore depend on season variation. The shoreline changes were observed from 2013-2018 & 2020 (7 years); the length of the shoreline is 1.42 km. The baseline buffer is 100 m from the shoreline and the spacing between the transects is 5m.

4.2.2. Fish landing Facilities in Vypin Munambam Stretch

The fish landing facilities in the Vypin-Munambam stretch are negligible; it points to a critical issue in the local fishing infrastructure. Inadequate or absent fish landing facilities can have several detrimental effects on the fishing community and the fishing industry in the region. Here are some potential consequences of a lack of fish landing facilities:

- **Safety Concerns:** Without proper fish landing facilities, fishermen may be forced to land their catches on open beaches or less secure areas. This can result in safety risks for both fishermen and their equipment.
- **Loss of Catch:** Landing fish without appropriate facilities can lead to damage and deterioration of the catch. This results in post-harvest losses and reduced economic returns for fishermen.
- **Limited Access to Markets:** The absence of fish landing facilities can hinder fishermen's access to markets, both local and regional. This, in turn, affects their ability to sell their catches efficiently and secure fair prices.
- **Inefficient Operations:** The lack of facilities may lead to less efficient fish handling and processing. This can negatively impact the quality and freshness of the catch and the profitability of the fishing operations.
- **Environmental Impact:** Open beach landings can have environmental consequences, such as the contamination of coastal areas and water bodies with fish waste, byproducts, and other materials.
- **Economic Hardship:** Fishing communities in the Vypin-Munambam stretch also face economic hardship due to the lack of proper fish landing facilities. This can result in lower income for fishermen and reduced economic activity in the region.

- **Development Hindrance:** The absence of substantial fish landing facilities can hinder the overall development of the local fishing industry especially the traditional fisherfolk and the growth of related industries, such as fish processing and tourism.

Given these potential consequences, it is essential for authorities to recognize the need for improved fish landing facilities in the Vypin-Munambam stretch. Addressing this issue may require investments in infrastructure development, including berthing areas, cold storage, processing units, and hygiene standards, to support the safety and economic well-being of the fishing community and the sustainable growth of the fishing industry in the region.

Fish landing facilities in the Vypin-Munambam stretch of Ernakulam district are essential for the sustainable development of the local fishing industry, the livelihoods of fishermen, and the overall economic and social well-being of the region. These facilities promote safety, efficiency, and better access to markets while contributing to the preservation and enhancement of the local fishing heritage.

4.3. PROJECT OBJECTIVES

- **Erosion Control:** The primary objective is to mitigate the impact of coastal erosion in the Vypin-Munambam stretch. Erosion can lead to the loss of land, property, and infrastructure, including fishing facilities, making it essential to protect the coastline.
- **Stable Beach:** Maintaining a stable beach helps preserve the natural environment, protect coastal ecosystems, and ensure the safety of coastal communities, including fishermen. A stable beach provides a secure and reliable environment for fishing activities.
- **Security for Fishermen:** The project seeks to provide a secure living environment for fishermen in the region. Shore protection measures not

only protect against erosion but also enhance the safety of the fishing communities and their assets.

- **Infrastructure Development:** Develop essential infrastructure components, including beach berthing facility, auction facilities, drainage, and portable water facility, to support the efficient flow of fish and seafood products.
- **Preservation of Infrastructure:** Protecting the coastline is vital for safeguarding fishing infrastructure, such as fish landing facilities, boats, and equipment. It ensures that these assets remain operational and functional.
- **Minimize Post-Harvest Losses:** Reduce post-harvest losses by ensuring immediate handling, processing, and cold storage of fish and seafood products, preserving their quality and freshness.
- **Support Local Livelihoods:** Enhance the livelihoods of local fishermen and fishing communities by providing better access to markets and improved infrastructure for their operations.
- **Promote Sustainable Fishing Practices:** Encourage the use of sustainable and responsible fishing practices that protect marine ecosystems and fish stocks.
- **Access to Markets:** Improve access to local, regional, and international markets, allowing fishermen to secure fair prices for their catches and support the local economy.
- **Environmental Stewardship:** Implement environmental measures, such as groyne construction, to protect coastal areas, manage sedimentation, and reduce erosion.
- **Regulatory Compliance:** Ensure that the fish landing facilities meet local and national regulatory standards, including hygiene, safety, and environmental requirements.
- **Tourism Promotion:** Leverage improved fish landing facilities to attract tourists interested in fresh seafood and promote tourism in the area.
- **Community Development:** Contribute to broader community development by creating job opportunities, stimulating local industries, and fostering a sense of pride and identity among local residents.

- **Economic Growth:** Promote economic growth in the Vypin-Munambam stretch by strengthening the fishing industry, enhancing income for fishermen, and increasing revenue from seafood exports.
- **Sustainable Resource Management:** Emphasize the responsible management of fishery resources and the preservation of the region's fishing heritage.
- **Quality Assurance:** Implement quality control measures and standards to ensure that fish and seafood products meet international quality requirements.
- **Infrastructure Maintenance:** Establish a framework for the ongoing maintenance and sustainability of the developed fish landing facilities to ensure their long-term viability.

These objectives aim to transform the Vypin-Munambam coastal stretch into a thriving hub for the fishing industry, supporting the well-being of local fishermen and contributing to the economic and social development of the region while safeguarding the coastal environment.

4.4. PROJECT LOCATION

4.4.1. Project Location

Vypin is one of the group of islands that form part of the city of Kochi , in the Indian state of Kerala. Vypin forms a barrier island which lies between the Arabian Sea in the west and the Cochin backwaters formed by the various distributaries of Periyar river, in the east. The northernmost end of the island lies on the estuary of the Periyar river in Muziris (Kodungallur), and the southernmost end in the mouth of the Cochin Backwaters in Kalamukku near Fort Vypin. The island is about 27 kilometres (17 mi) long and is connected to mainland Kochi by a series of bridges known as the Goshree bridges, which start at Kalamukku in Vypin, touch other two islands and then finish at Marine Drive covering a total distance of around three km (1.9 mi). Vypin is 58th most

densely populated islands in the world. Njarakkal is one of the most densely populated locations within Vypin

Munambam is a suburb of Kochi, India at the north end of Vypeen Island, surrounded by the Arabian Sea on the west, Periyar river on the east, and a mouth of the sea on the north.It comes under Edavanakkad Panchayath. It belongs to Central Kerala Division. It is located 32 KM towards North from District headquarters Kakkanad. 18 KM from Vypeen. 241 KM from State capital Thiruvananthapuram

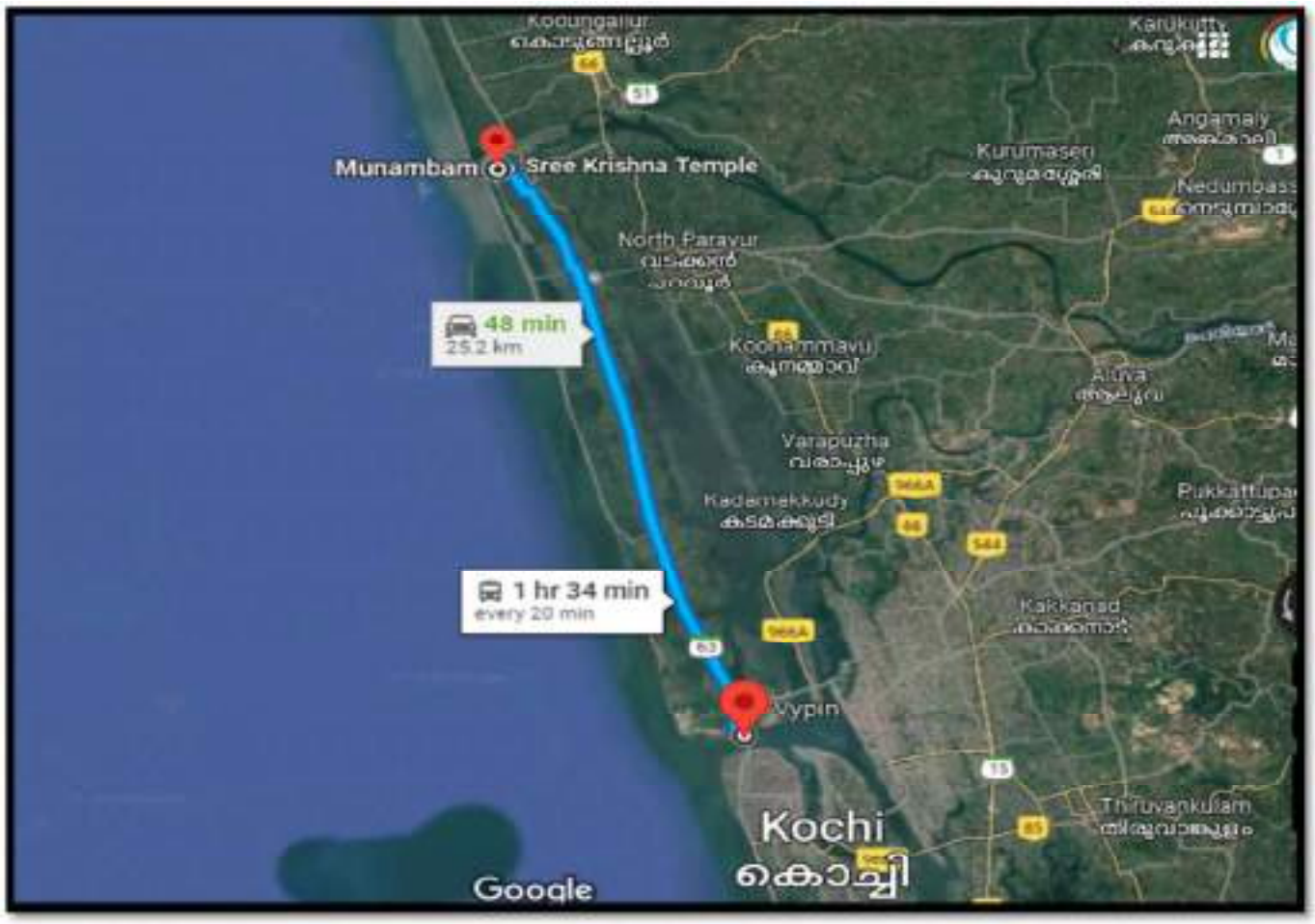


Fig- 6- Google Image- Vypin to Munambam Stretch
Co-ordinates- Vypin 9.97439, 76.24488
Munambam- 10.18507, 76.16629

For the preparation of the proposal for Shore protection along the coastal stretch from Vypin to Munambam, few of the sites are identified and marked. The stretch is noted from LNG Petronet to Munambam training wall, spanning for about 24 km. The location has been marked as pillar 1-18 as shown in Fig 4 a and b and the location between pillars is marked as cell 1-17 as shown in Table 12.

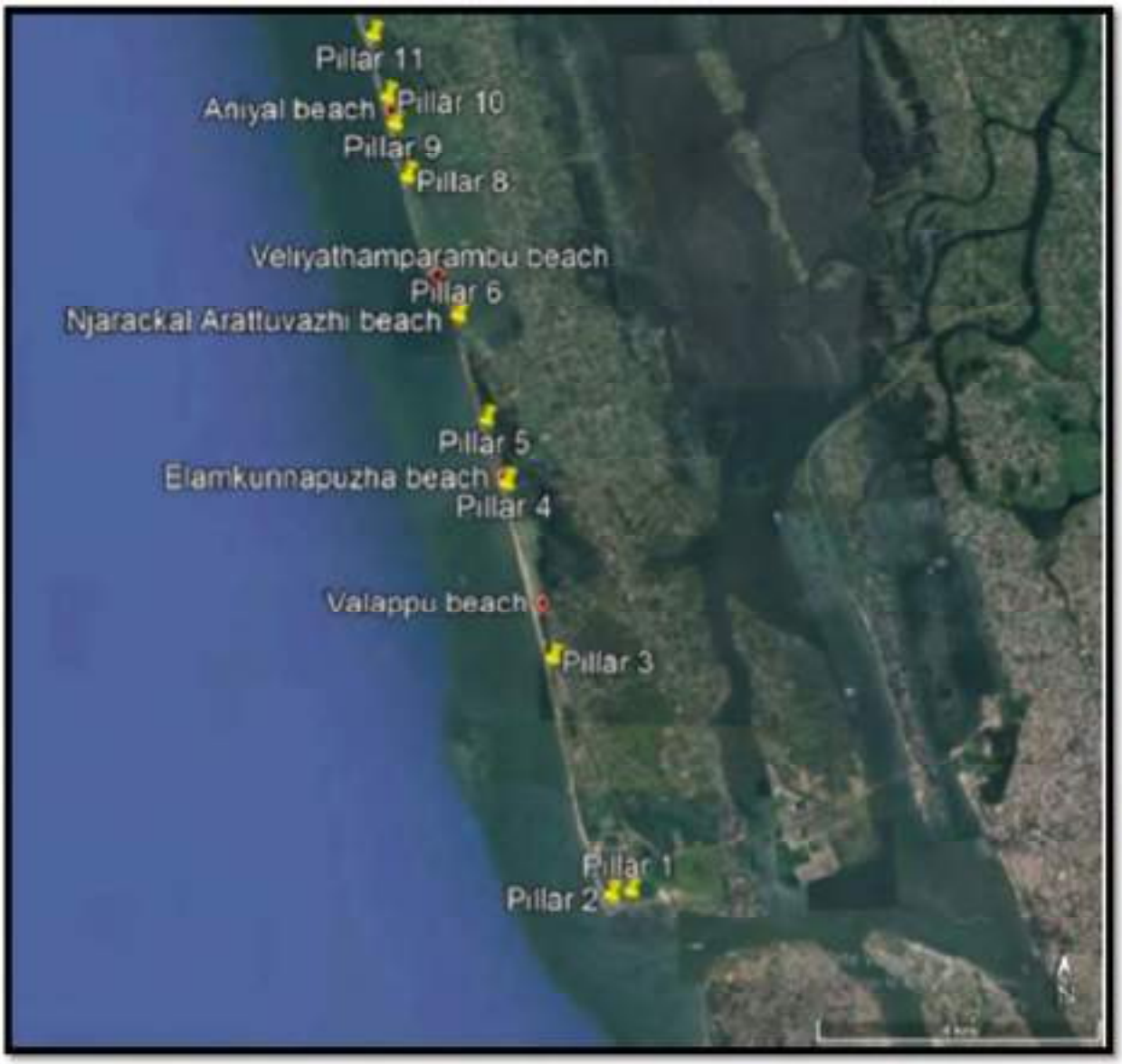


Fig-7 a Location- - Pillar 1 to 11

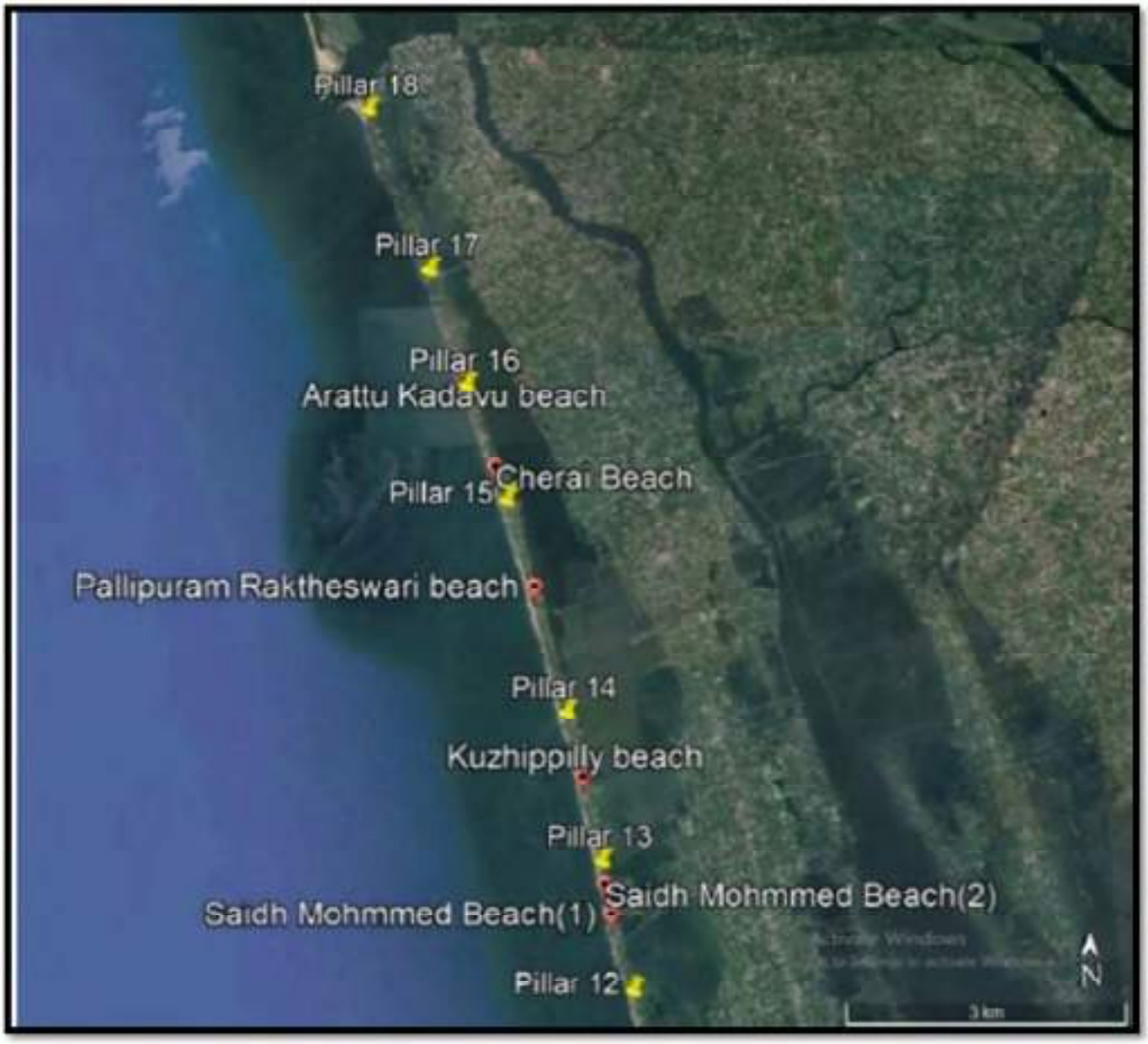


Fig-7 b Location- - Pillar 12 to 18

Table.12. Location description of Cells and Pillars

Cells	Pillars	Shore Length (km)	Type of structure	Erosion/ Accretion	Site visit identified location:	Latitude Longitude of cells	Sea Wall/ Groyne (km)	Open Coast (km)
Cell 1	Pillar 1-2	0.37	South of LNG jetty	High Accretion	-	9°58'27.17" N 76°13'53.13" E	-	0.37
Cell 2	Pillar 2-3	3.4	Single Training Wall	High Erosion	-	9°59'22.28" N 76°13'13.05" E	-	3.4
Cell 3	Pillar 3-4	2.5	End of IOCL LNG Terminal	High Erosion	Valappu	10° 1'8.17" N 76°12'50.23" E	-	2.5
Cell 4	Pillar 4-5	0.93	Sea Wall	-	Elankunnapuzha	10° 1'48.84" N 76°12'35.37" E	0.93	-
Cell 5	Pillar 5-6	1.49	Sea Wall	-	Njarakkal Azhuvazhi	10° 2'30.61" N 76°12'24.01" E	1.49	-
Cell 6	Pillar 6-7	0.25	Single Groyne and sea wall	Moderate Erosion	-	10° 2'53.63" N 76°12'18.05" E	0.13	0.12
Cell 7	Pillar 7-8	1.9	Sea Wall	-	Velyathuruparambu	10° 3'22.67" N 76°12'3.43" E	1.9	-
Cell 8	Pillar 8-9	0.75	Groyne Field	Moderate Erosion	-	10° 4'7.84" N 76°11'51.43" E	0.75	-
Cell 9	Pillar 9-10	0.4	Open Beach	Moderate Accretion	Anjyal beach	10° 4'25.19" N 76°11'47.40" E	-	0.4
Cell 10	Pillar 10-11	0.88	Open beach, Narrow strip	Moderate Accretion & Erosion	-	10° 4'46.04" N 76°11'42.43" E	0.44	0.44
Cell 11	Pillar 11-12		Sea wall	-	-	10° 5'10.93"N 76°11'34.49"E	0.84	-
Cell 12		1.4			Saidh Mohammed 1	10°5'47.11" N 76°11'24.28" E	0.89	Active
	Pillar 12-13		Open Coast, Seawall & Groyne Field	Moderate Erosion & accretion	Saidh Mohammed 2	10°5'57.76" N 76°11'21.90" E	-	0.51
Cell 13	Pillar 13-14	1.62	Open Coast	Moderate Erosion	Kuzhuppilly beach	10°6'34.49" N 76°11'14.56" E	-	1.62
Cell 14	Pillar 14-15	2.35	Open Coast, Seawall	Moderate Erosion	Pallipuram Rakthesvari	10°7'40.55" N 76°10'57.99" E	0.35	2
Cell 15	Pillar 15-16	1.3	Open coast	Moderate Erosion	Chera	10° 8'32.37" N 76°10'41.28" E	0.84	0.46
Cell 16	Pillar 16-17	1.31	Seawall & Open coast	Moderate Erosion	Arattu Kadavu	10° 9'12.40" N 76°10'26.74" E	1.33	-
Cell 17	Pillar 17-18	1.85	Sea Wall	-	-	10°10'2.82" N 76°10'8.43" E	1.85	-

4.4.2. Project Connectivity

Table.13. Location Connectivity

Place	Nearest Railway station	Nearest Airport	Nearest NH
Vypin	Edapalli (20.31 km)	Kochi International Airport (27.9 km)	NH966A (Vallarpadam -ICT Highway) NH 66 (Kodungallur-Paravur-Ernakulam Highway)
Munambam	Edapalli (21.09 km)	Kochi International Airport (29.3 km)	NH966A (Vallarpadam -ICT Highway) NH 66 (Kodungallur-Paravur-Ernakulam Highway)

4.4.3. Details of Existing Shore Protection Structures in the proposed site

Table. 14. Existing Shore Protection Facility

Site Name	North Lat/long	South Lat/long	Distance	Existing Structure
Malippuram, Chappakadavu	N 10°1'11.0604" E 76°12'47.4876"	N 10°1'15.8052" E 76°12'46.3104"	0.15 km	Nil
Njarakkal, Near Krishi Vitjaan Kendra	N 10°2'37.78951" E 76°12'23.14688"	N 10°2'38.79388" E 76°12'22.41781"	0.18 km	Sea wall at both sides, with a beach opening at southern end.
Veliyathamparambu	N 10°2'49.94768" E 76°12'19.41192"	N 10°2'53.8669" E 76°12'17.50619"	0.13 km (beach opening)	Groynes and sea wall at both the sides
Puthenkadappuram	N 10°3'53.60576" E 76°11'55.69982"	N 10°3'57.80577" E 76°11'54.10752"	0.14 km	Series of 6 groins at north and sea wall at southern
Aniyal	N 10°4'36.05833" E 76°11'44.34713"	N 10°4'39.22827" E 76°11'44.05199"	0.06 km	At southern end there is a groyne of 50m length at a distance of 130m from sea wall
Pazhangadu-Puthenkadappuram	N 10°4'58.64154" E 76°11'39.52792"	N 10°5'1.18003" E 76°11'38.20931"	0.1 km (beach opening)	Sea wall at both ends
Saidh Mohammed beach-2	N 10°5'51.75364" E 76°11'23.263"	N 10°5'55.86458" E 76°11'22.20465"	0.13 km	A series of 6 located south of the beach stretch

Kuzhuppilly	N 10°6'32.688" E 76°11'14.5356"	N 10°6'36.2916" E 76°11'13.9812"	0.11 km	Nil
Ayyambilly	N 10°7'5.7576" E 76°11'6.4176"	N 10°7'10.7328" E 76°11'5.2836"	0.16 km	Nil
Arattukadavu	N 10°8'57.40798" E 76°10'32.9444"	N 10°8'59.5872" E 76°10'32.15672"	0.07 km (beach opening)	Both end covered with sea wall
Puthuvypen	N 9°59'51.9019" E 76°13'5.9023"	N 9°59'58.5019" E 76°13'4.8015"	0.21 km	Nil
Valappu	N 10°0'20.37899" E 76°13'0.49256"	N 10°0'45.35078" E 76°12'54.41616"	0.79 km	Nil
Saidh Mohammed beach-2	N 10°5'55.86458" E 76°11'22.20465"	N 10°8'28.068" E 76°10'42.78"	4.83 km	
Kuzhuppilly Beach				
Raktheswari Beach				
Cherai Beach				

4.5. PROJECT COMPONENTS

The project components have been derived based on the shoreline changes assessed along the coast through satellite image processing techniques and statistically analyzed using DSAS tool of ArcGIS software application by IIT, Madras. Significant dynamics in the shoreline changes were derived mostly due to the seasonal monsoon effects along the coast. The study states that erosion is more predominant during the southeast monsoon season. The shore protection in the proposed stretch along with the fish landing facilities are briefed below:-

The proposed beaches are protected considering the potential activities undertaken in each area.

4.5.1.Valappu Beach

Valappu Beach is a popular fish landing area along the Ernakulam coast, situated in the vicinity of BPCL and IOCL oil refiner facilities.

Image 4. Google image- Valappu beach

Based on the satellite imagery studies conducted this site has been observed to undergo moderate erosion rates. IIT Madras has already proposed a few costal protections measures adjacent to the BPCL and IOCL facilities; in addition to the aforementioned measures, commissioning a singular 820 m long section of a submerged geo-tube parallel to the shoreline is proposed, which would effectively function as an offshore submerged breakwater. Morphodynamics induced around submerged breakwaters is strongly influenced by its positioning. The bed variations were shown to increase when the structures are progressively located offshore; when dissipative breaking mechanisms occur, decreasing inshore erosion is accompanied by an equally fast decrease of offshore erosion. Analysis of the vorticity fields show that breakwaters placed far from the shoreline induce an evolution of the vortices generated by breaking waves rather different from the one due to breakwaters placed closer to the shoreline (Postacchini et al., 2016). This offshore submerged geo-tube is proposed to erected at -5m water depth, 1600 m away from the shoreline. Fig 8 details the layout of the proposed protection measure. The adopted layout dimensions satisfy the conditions (Ls/X > 0.5, i.e., ratio of the breakwater length to its distance from the shore is 0.53 which is favourable for salient formations) put forth by Dally and Pope (1986) Chasten et al., (1993) and Seiji et.al, (1987) for the formation of salient for an offshore emerged structure. According to Lorenzoni et al., (2012) submerged configurations show larger shoreline retreats than the emerged ones at the same position and for the same wave attack conditions.

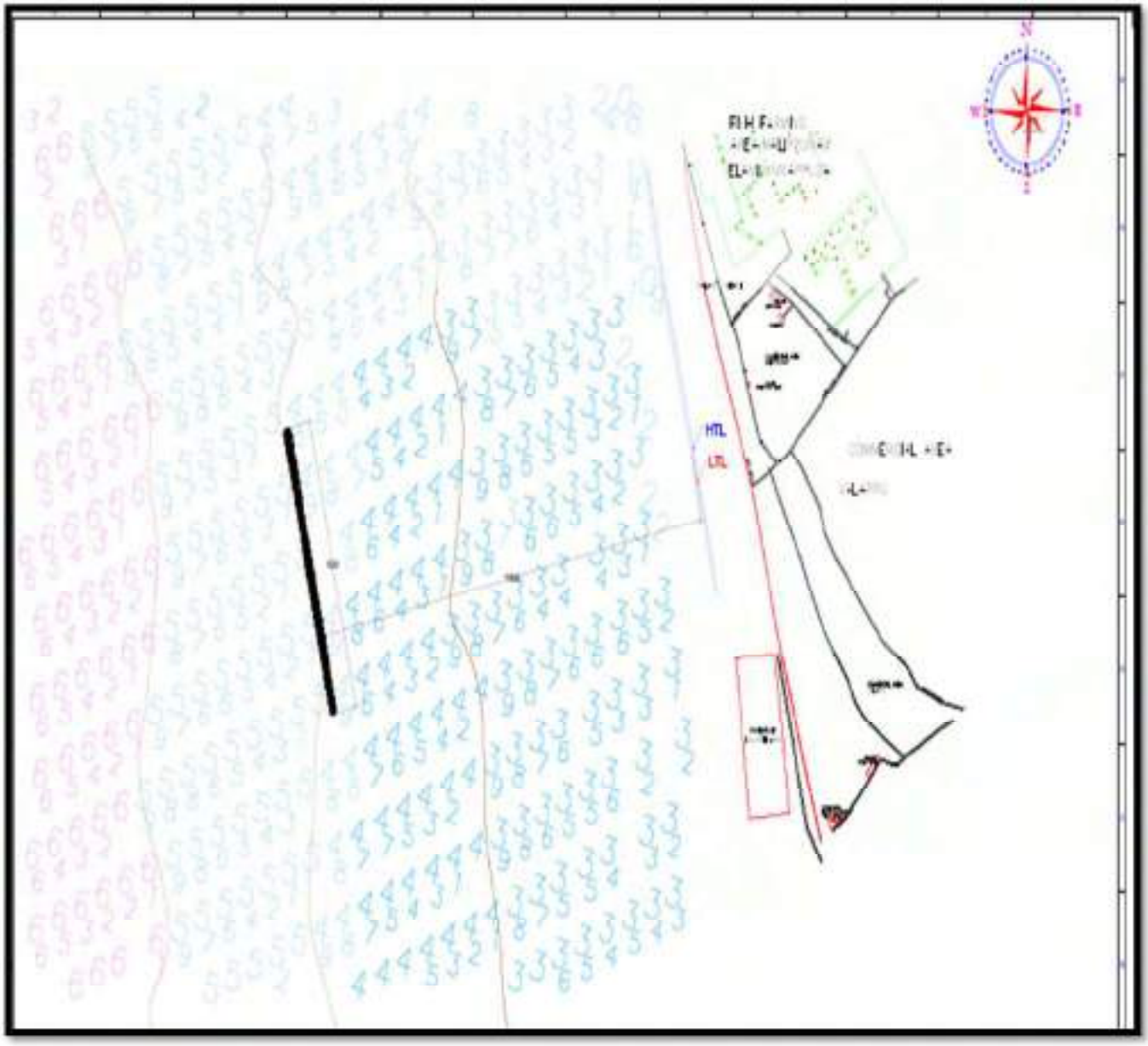


Fig-8- Layout- Valappu beach

An Auction hall building of size 28.3m x 6.4m is proposed in the Valappu beach. Sufficient beach area is available for construction of the auction hall, aslo there is road access to the proposed area.

Image 5. Proposed Area at Valappu beach

For the auction hall, coconut piling of length 6m long is provided for foundation. RCC M20 provided for foundations, centering & shuttering, Reinforcement cement concrete work (M20) in walls is provided for super structure. Necessary Steel reinforcement, plastering and painting works are also included in the Auction hall.

Provision for construction of a toilet block of size 12.5m x 5.1m is also included in the proposal. For the toilet block, RR masonry with cement mortar 1:6 is provided for the foundation. Solid block masonry of size 30x20x15cm and 40x20x10 cm are provided for super structure. Ceramic tiling is provided in the floor and in the bathroom region. Necessary fittings are also provided for toilet block. Other provisions include concrete parking area proposed near the Auction hall, construction of drain etc. Provisions for sea wall strengthening, sub soil investigation, water supply and sanitary arrangement, Electrification and yard lighting are also included in the proposal.

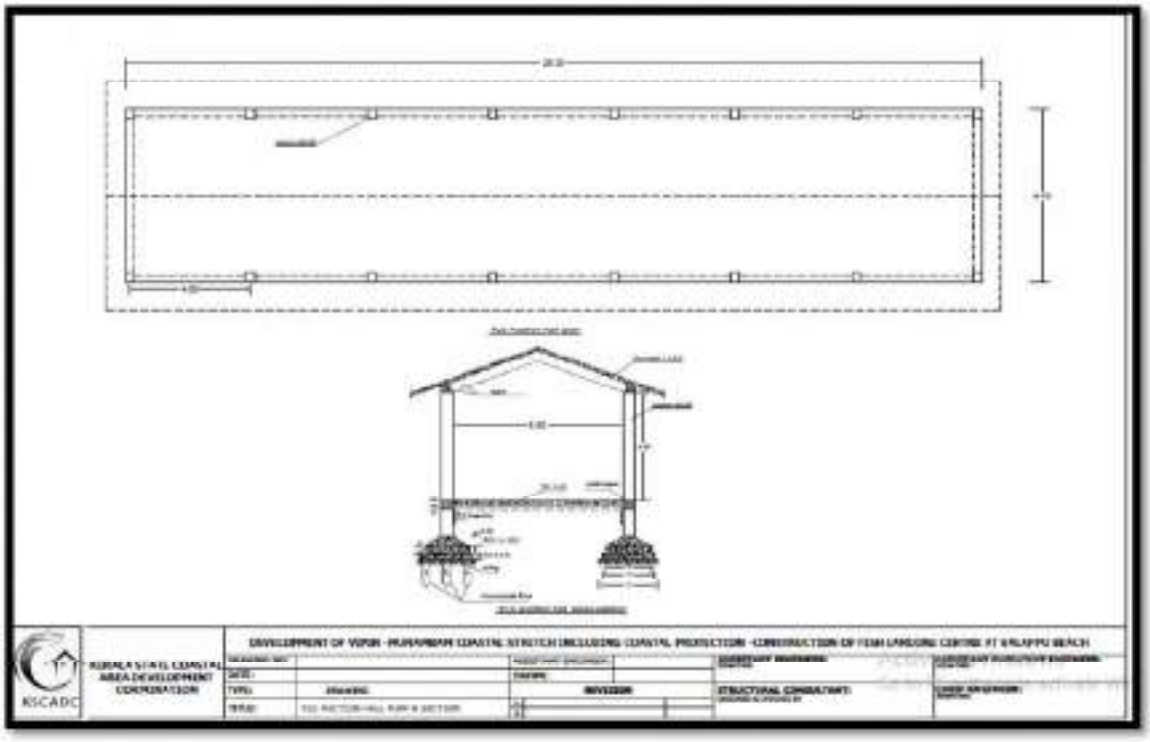


Fig-9- Auction hall, Valappu beach

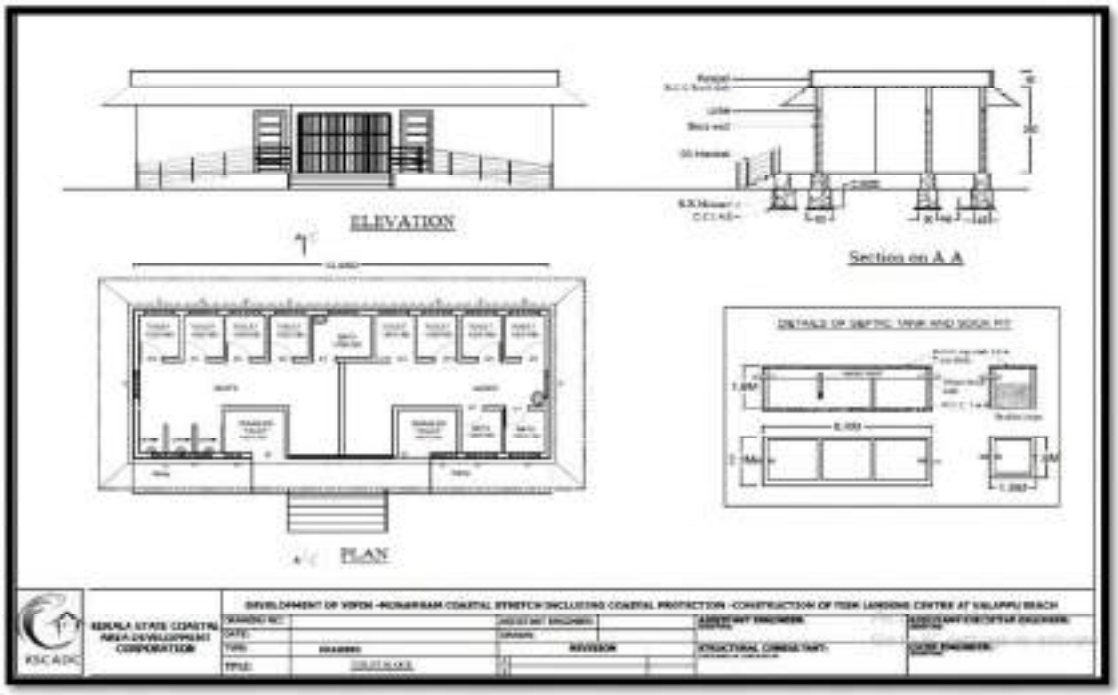


Fig-10- Toilet Block, Valappu beach

An amount of Rs. 25.00 crore is required for construction of Modern Integrated Fish Landing facilities at Valappu beach in Vypin Munambam stretch of Ernakulam district. **(Estimate and plan attached as Annexure 1)**

4.5.2. Malipuram

This coast is identified to experience high erosion at the rate of about -10m/yr through remote sensing studies. Although this site has been identified as a fish landing centre, there is an urgent need to protect the eroding coastline.

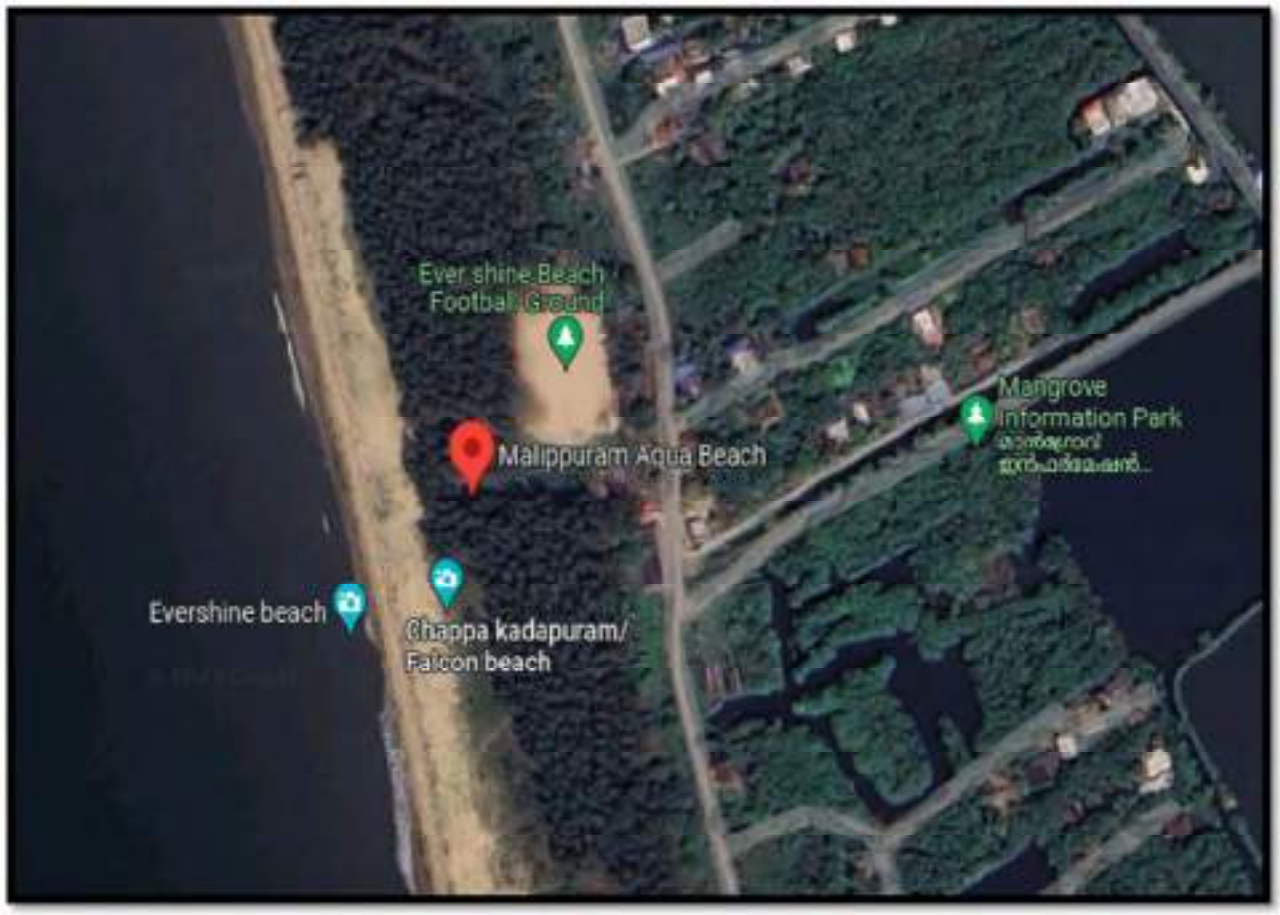


Image 6. Google image- Malipuram

Therefore, a series of six transitional groynes are proposed to be constructed across a stretch of about 1 km. Four number of T groynes, two on either ends and two number of straight groynes in the central section are proposed. The straight groynes can be further extended to form a fishing harbour if necessary. A base landing width of 250 m is provided to accommodate sufficient number of fishing vessels; these groynes extend upto a maximum water depth of about -2 m. The longest groyne in this series is about 120 m long and the shortest groyne is about 50 m long as seen in Fig 11.

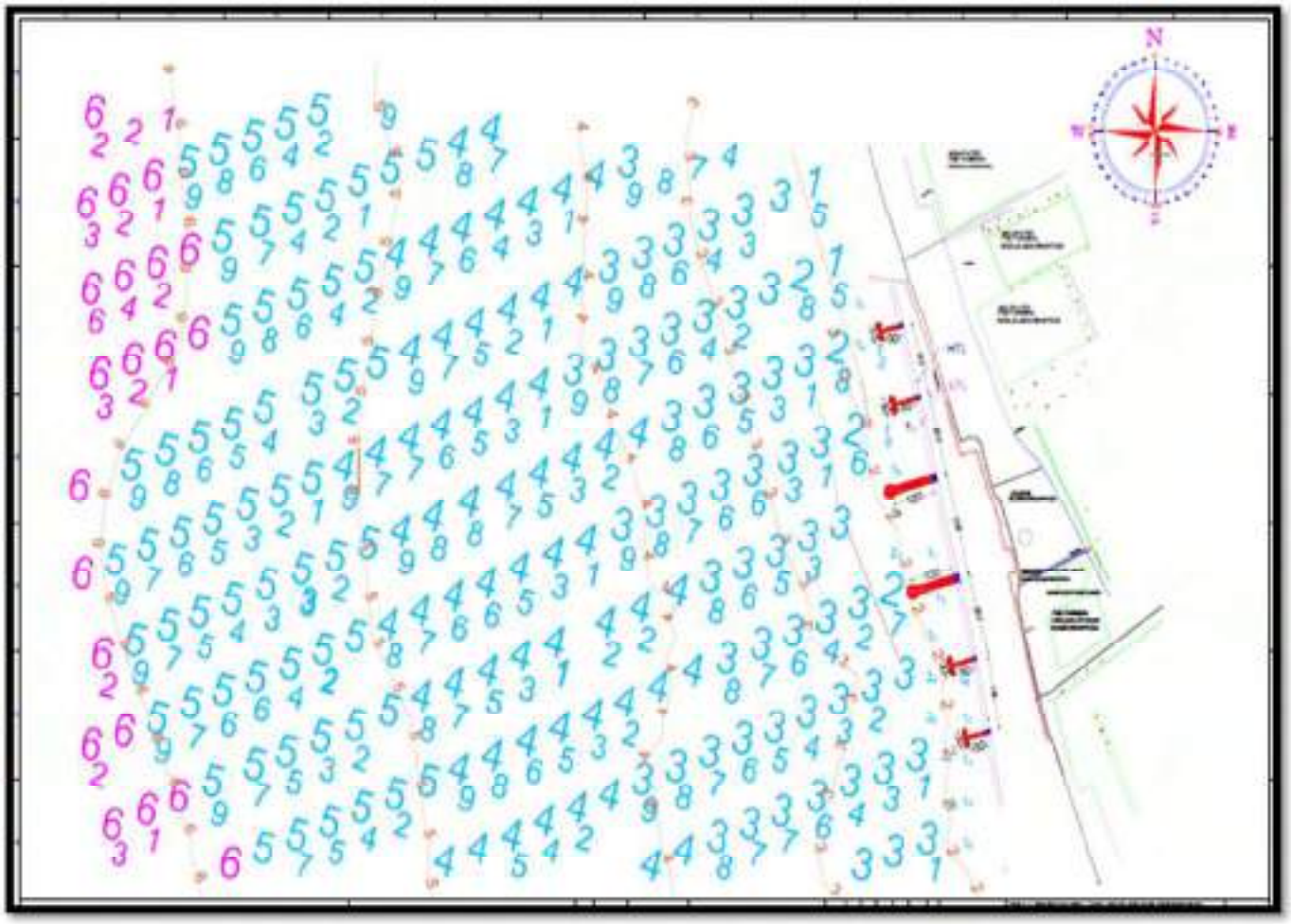


Fig-11- Layout- Malipuram

An Auction hall building of size 28.3m x 6.4m is proposed at Malipuram beach. Sufficient free land is available at Malipuram beach with sufficient road access.

Image 7. Proposed Area at Malipuram beach

For the auction hall, coconut piling of length 6m long is provided for foundation. RCC M20 provided for foundations, centering & shuttering, Reinforcement cement concrete work(M20) in walls is provided for super structure. Necessary Steel reinforcement, plastering and painting works are also included in the Auction hall. Provision for construction of a toilet block of size 12.5m x 5.1m is also included. For the toilet block, RR masonry with cement mortar 1:6 is provided for the foundation. Solid block masonry of size 30x20x15cm and 40x20x10cm are provided for super structure. Ceramic tiling is provided in the floor and in the bathroom region. Necessary fittings are also provided for toilet block. Other provisions include concrete parking area proposed near the the Auction hall. Provision for the construction of drain is also included. Water supply and sanitary arrangement, Electrification and yard lighting are also included.

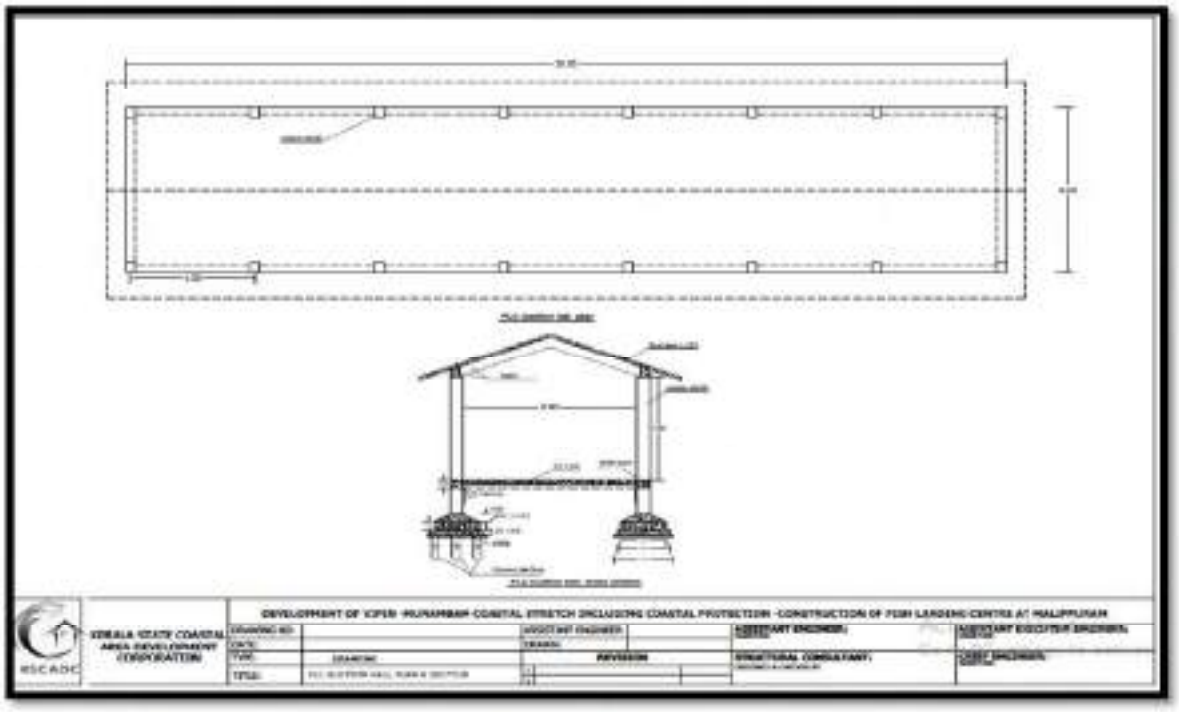


Fig-12- Auction hall, Malippuram

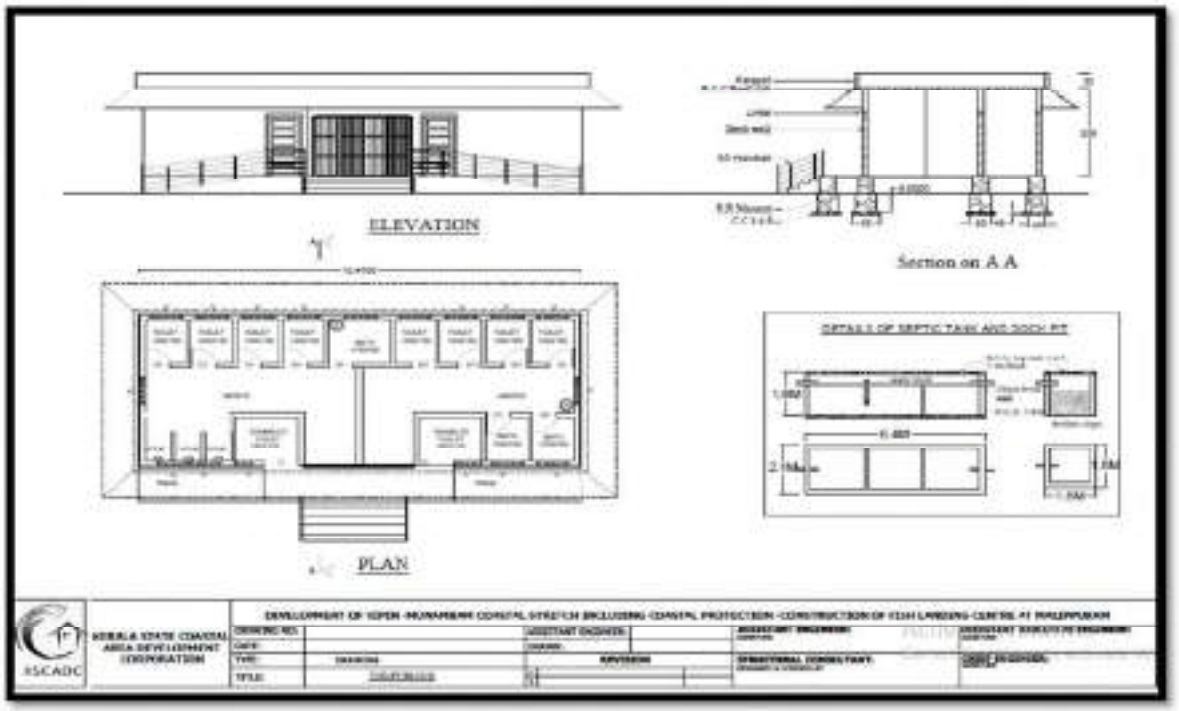


Fig-13- Toilet block, Malippuram

An amount of Rs. 25.00 crore is required for construction of Modern Integrated Fish Landing facilities at Malipuram beach in Vypin Munambam stretch of Ernakulam district. **(Estimate and plan attached as Annexure 2)**

4.5.3. Veliyathamparambu

This stretch of the coastline identified as a fishing landing centre is already protected with a seawall structure to its south and a single groyne exists in the northern side.

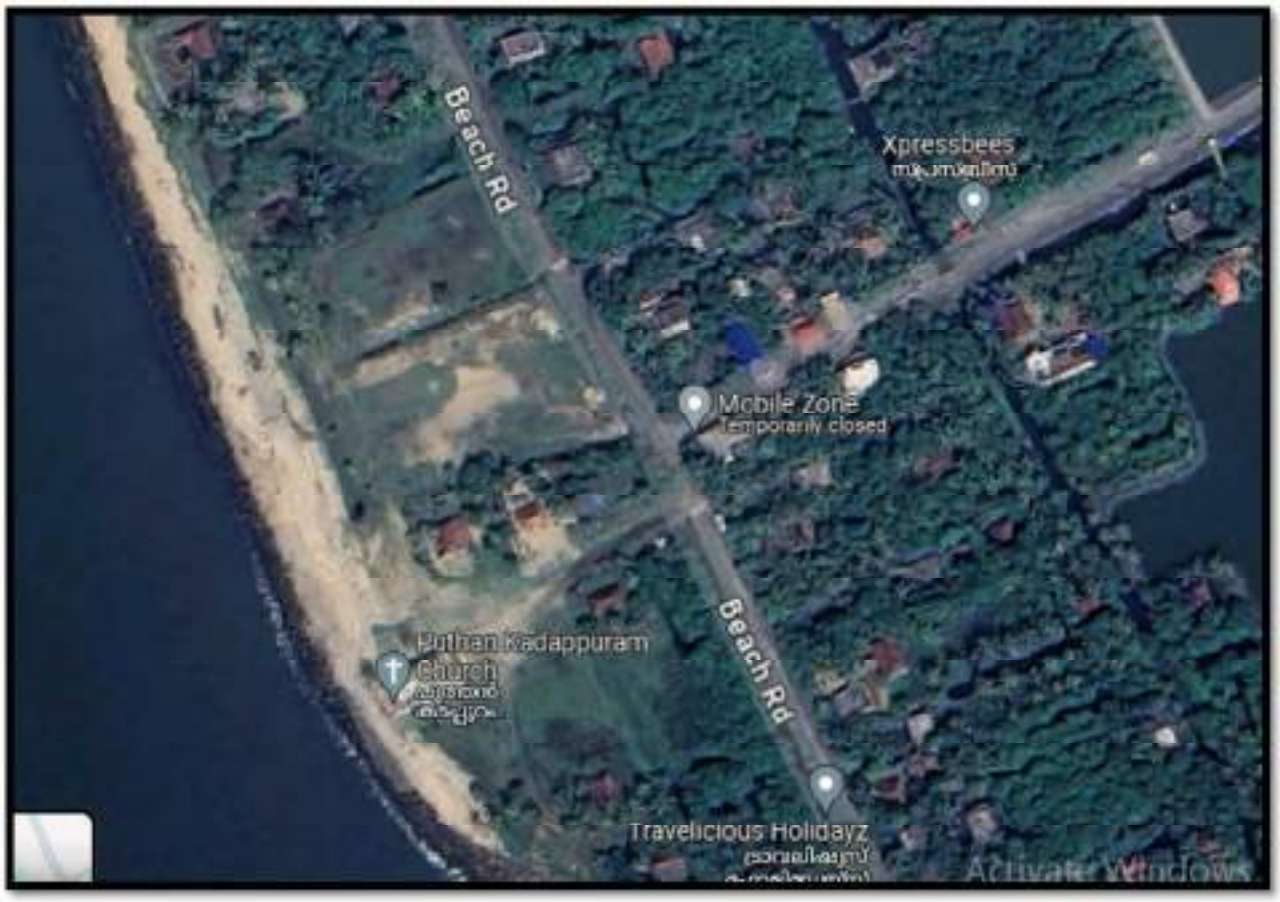


Image 8. Google image- Veliyathamparambu

The rate of erosion across this stretch is inferred to be less based on the satellite imagery studies, since it is already protected. Although a pair of inclined groynes as seen in Fig 14 are proposed to be constructed in order to effectively serve as a fish landing facility. These groynes are about 180 m long extending to water depths upto 3 m. Extension of Northern Groyne and provision of a new southern groyne is proposed. A filter layer of 1kg to 10kg category stone, Core layer using 100 to 300 kg stones , Toe Mound using 500 to 800 kg stones , Armour layer using 1.5T to 2.5T stones proposed here. In addition to that 2T tetrapods at 1.96m Thick and 4T tetrapods at 2.50m Thick is provided for armour layer

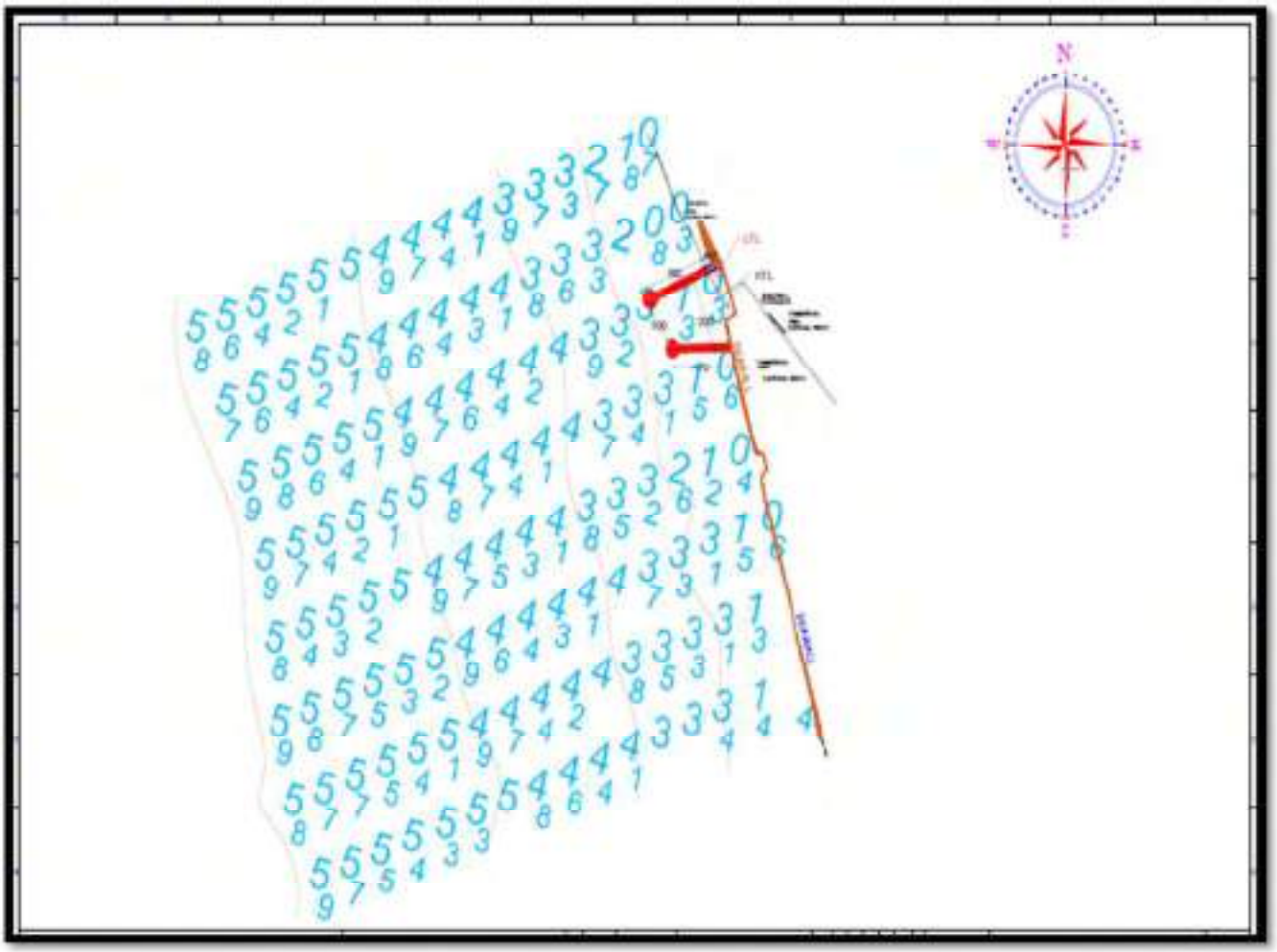


Fig-14- Layout- Veliyathamparambu

An Auction hall building of size 28.3m x 6.4m is proposed at Veliyathamparambuu beach. Sufficient free land with road access is available in Veliyathamparambu beach for FLC construction.

Image 9. Proposed Area at Veliyathamparambu beach

For the auction hall, coconut piling of length 6m long is provided for foundation. RCC M20 provided for foundations, centering & shuttering, Reinforcement cement concrete work (M20) in walls is provided for super structure. Necessary Steel reinforcement, plastering and painting works are also included in the Auction hall. Provision for construction of a toilet block of size 12.5m x 5.1m is also included in the estimate. For the toilet block, RR masonry with cement mortar 1:6 is provided for the foundation. Solid block masonry of size 30x20x15cm and 40x20x10cm are provided for super structure. Ceramic tiling is provided in the floor and in the bathroom region. Necessary fittings are also provided for toilet block. Other provisions include concrete parking area proposed near the Auction hall. Provision for the construction of drain is also included.

Provisions for water supply and sanitary arrangement, Electrification and yard lighting are also included

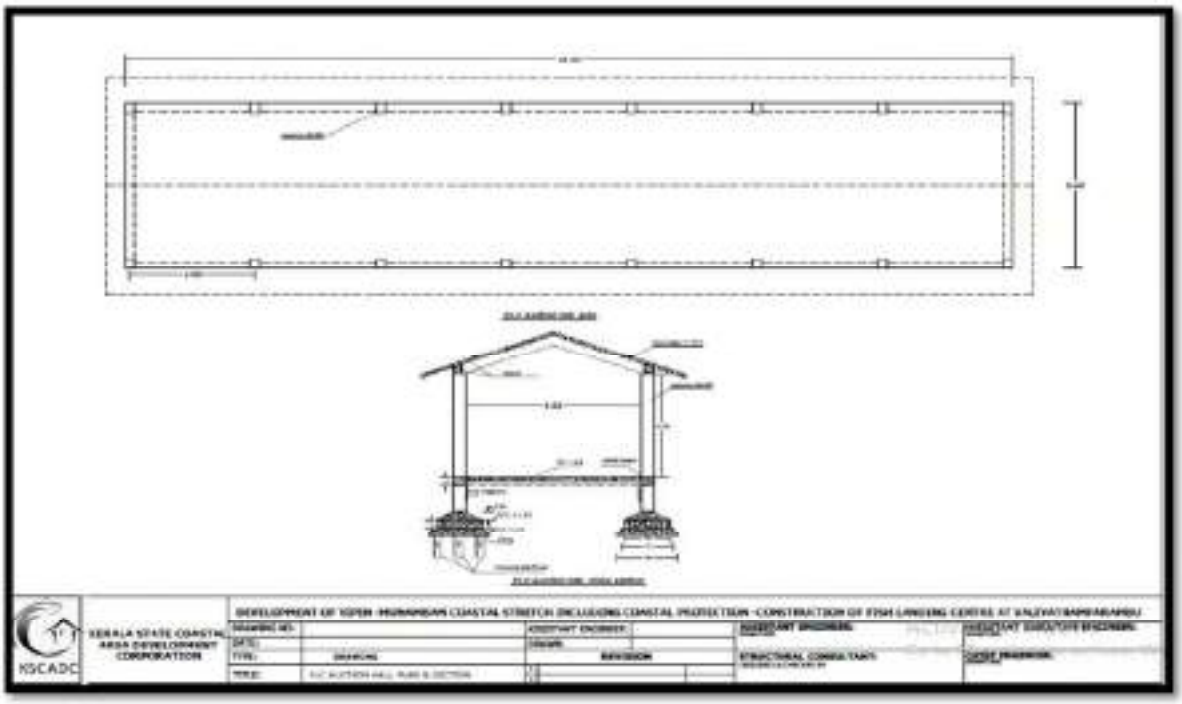


Fig-15- Auction hall, Veliyathamparambu

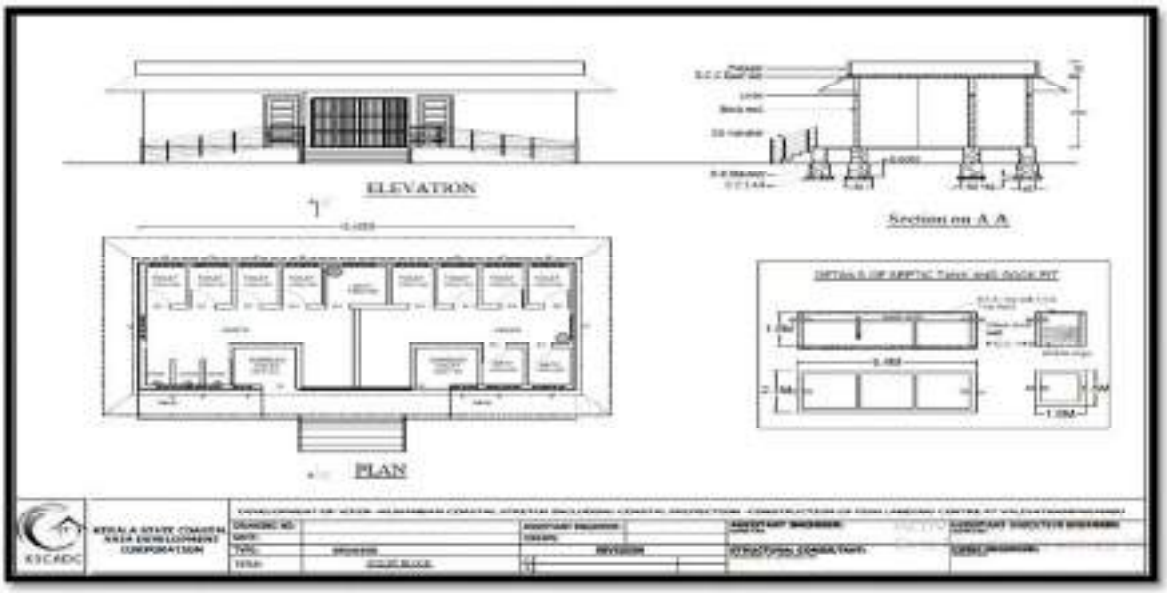


Fig-16- Toilet Block , Veliyathamparambu

An amount of Rs. 25.00 crore is required for construction of Modern Integrated Fish Landing facilities at Veliyathamparambu beach in Vypin Munambam stretch of Ernakulam district. **(Estimate and plan attached as Annexure 3)**

4.5.4. Puthenkadappuram

This stretch of the coastline identified as a fishing landing centre is already protected with a seawall structure to its south and groyne field on the northern side.

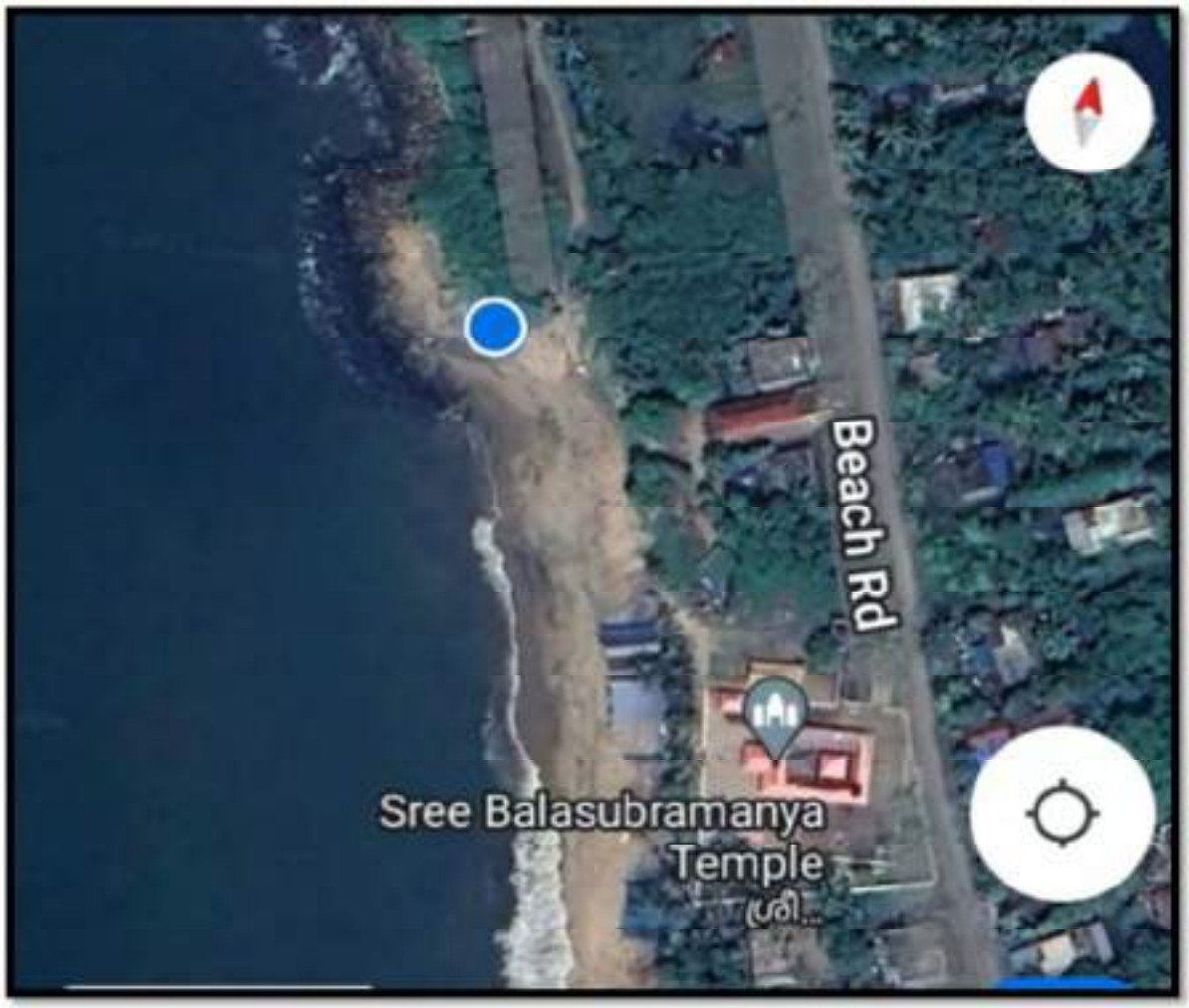


Image 10. Google image- Puthenkadappuram

A proposal to construct a pair of groynes as seen in Fig 17. is made, which includes the extension of an existing groyne on the northern side. A series of 2 transitional groynes are proposed. Groynes of length 180m and 150m are proposed. A filter layer of 1kg to 10kg category stone, Core layer using 100 to 300 kg stones , Toe Mound using 500 to 800 kg stones ,Armour layer using 1.5T to 2.5T stones proposed here. In addition to that 2T tetrapods of 1.96m Thickness and 4T tetrapods of 2.50m Thickness is provided for armour layer

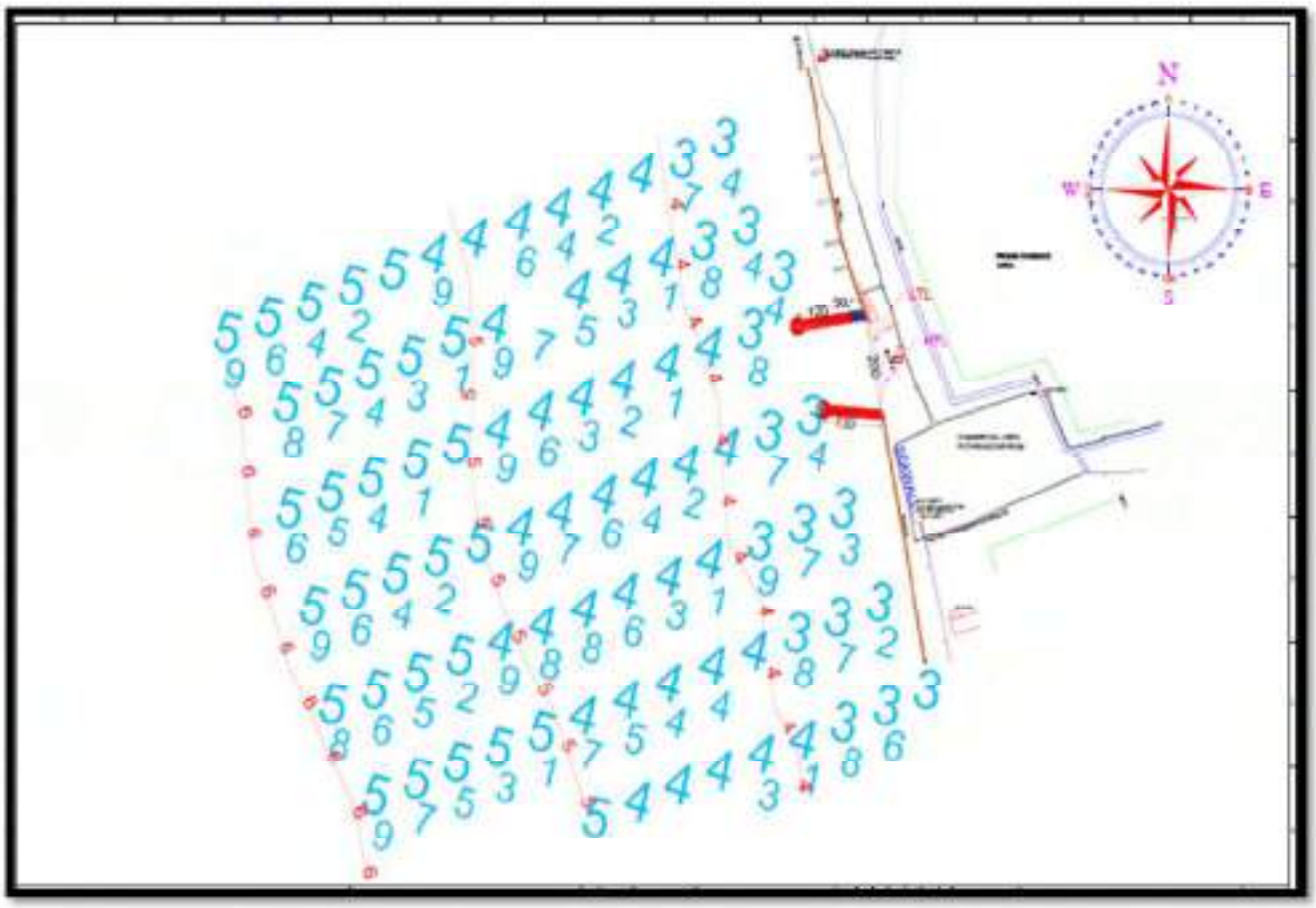


Fig-17- Layout- Puthenkadappuram

An Auction hall building of size 28.3m x 6.4m is proposed at Puthenkadapuram beach. An old Fish Landing Centre exits at Puthenkadappuram which is left abandoned due to its dilapidated condition. The fishermen of the area have requested to demolish the existing dilapidated FLC and to construct a new one to facilitate their day to day fishing activities.

Image 11. – Puthenkadappuram- Existing FLC

For the auction hall, coconut piling of length 6m long is provided for foundation. RCC M20 provided for foundations, centering & shuttering, Reinforcement cement concrete work (M20) in walls is provided for super structure. Necessary Steel reinforcement, plastering and painting works are also included in the Auction hall. Provision for construction of a toilet block of size 12.5m x 5.1m is also included in the estimate. For the toilet block, RR masonry with cement mortar 1:6 is provided for the foundation. Solid block masonry of size 30x20x15cm and 40 x 20 x 10 cm are provided for superstructure. Ceramic tiling is provided in the floor and in the bathroom region. Necessary fittings are also provided for toilet block. Other include concrete parking area near to the Auction hall. Provision for the construction of drain is also included in included. Sea wall strengthening, water supply and sanitary arrangement, Electrification and yard lighting are also included

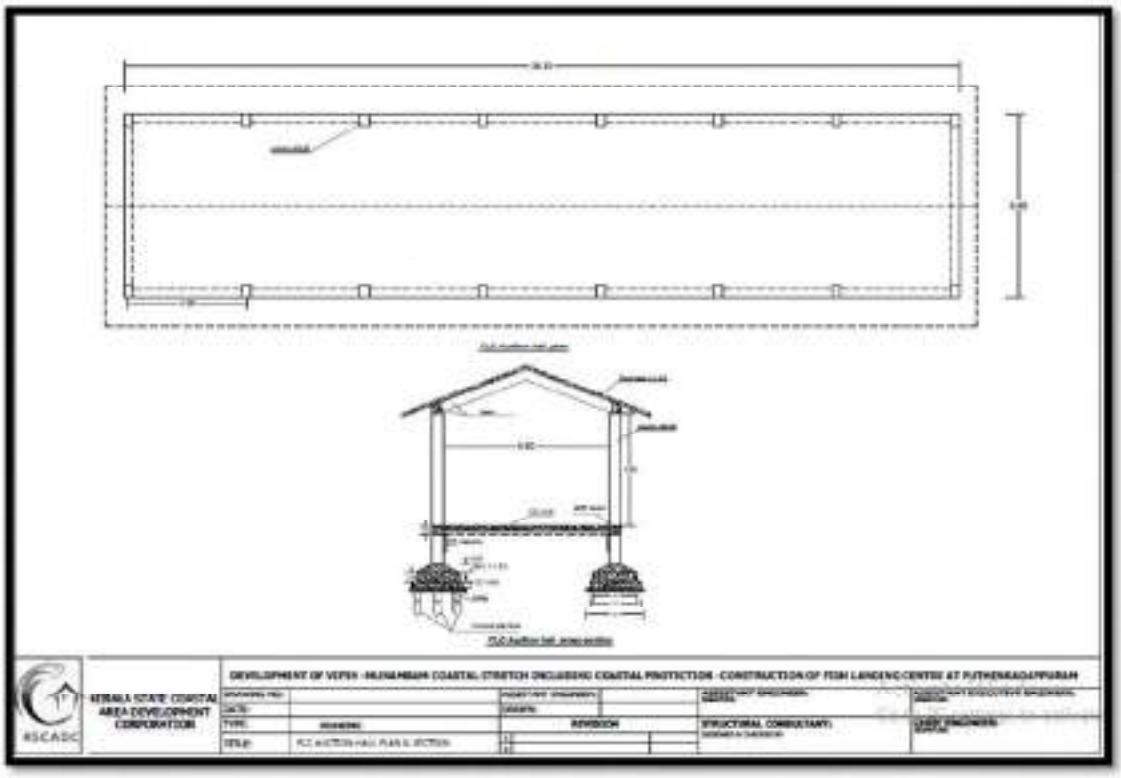


Fig-18- Auction hall, Puthenkadappuram

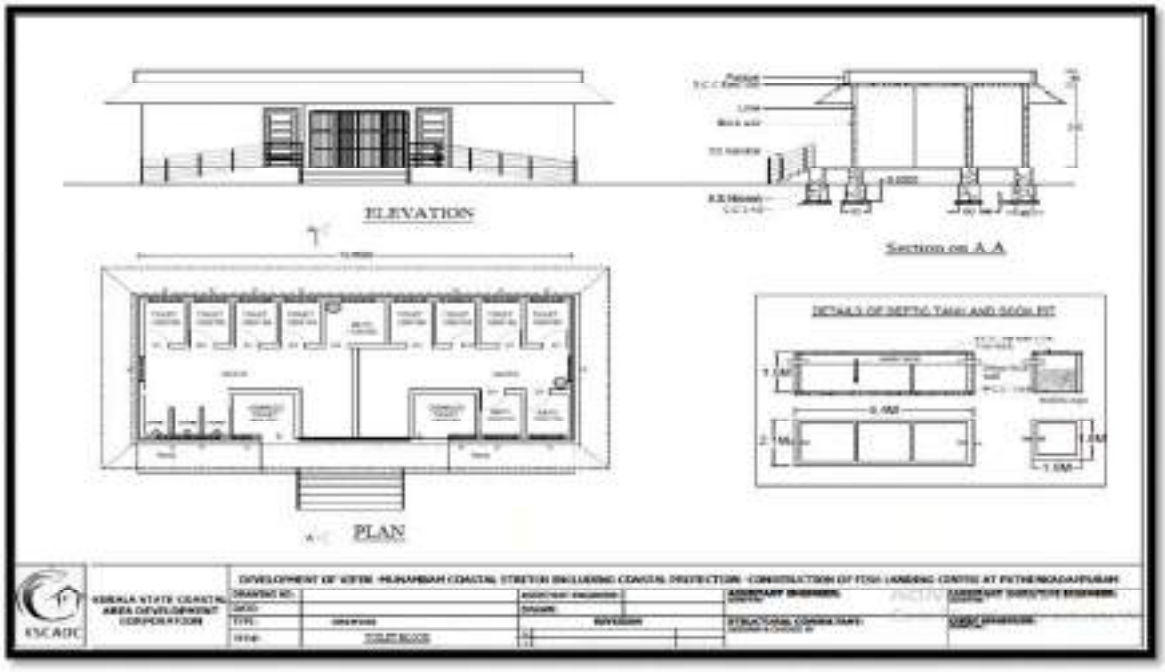


Fig-19.- Toilet Block, Puthenkadappuram

An amount of Rs. 25.00 crore is required for construction of Modern Integrated Fish Landing facilities at Puthenkadappuram beach in Vypin Munambam stretch of Ernakulam district. **(Estimate and plan attached as Annexure 4)**

4.5.5. Pazhangadu

This stretch of the coastline is identified as a fishing landing centre and it is already protected with seawall sections on either side.

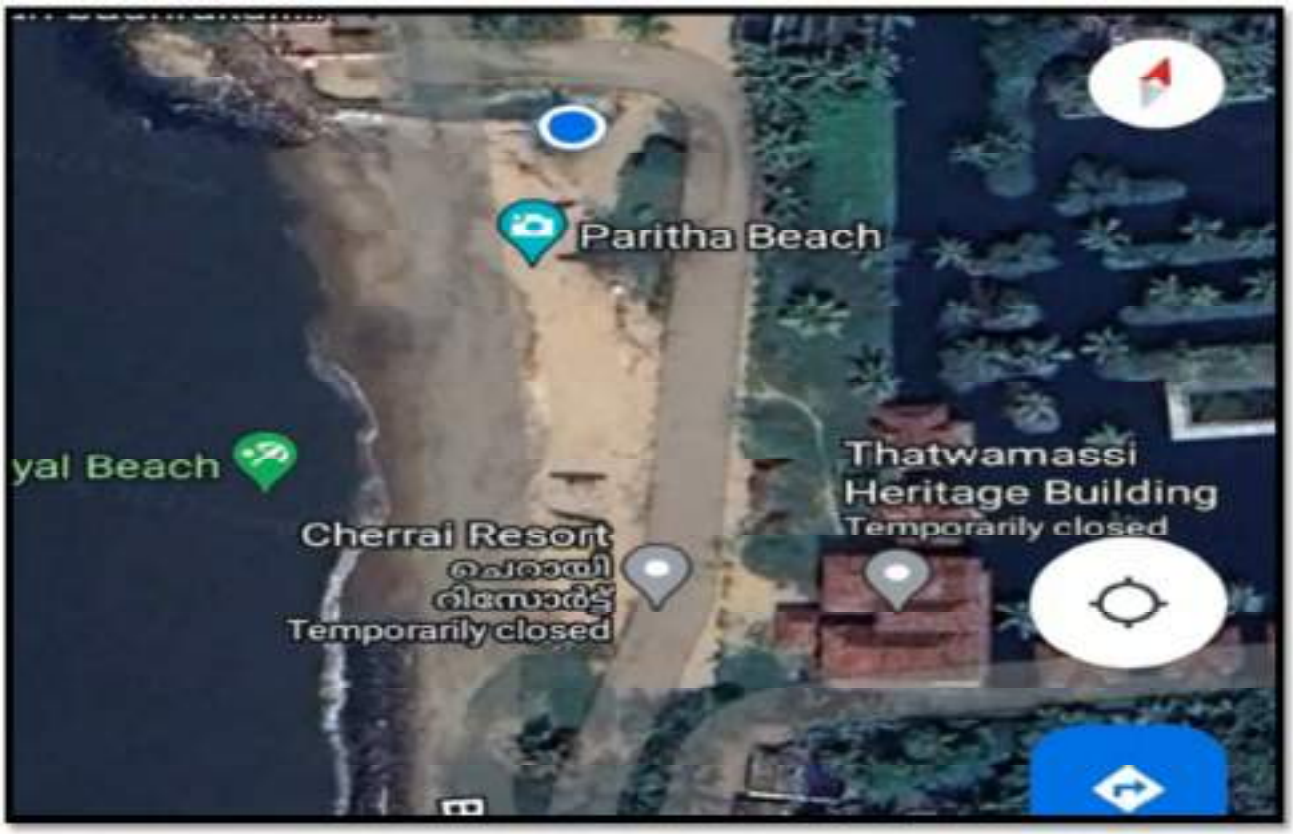


Image 12. Google image- Pazhangadu

A pair of groynes are proposed to be constructed as shown in Fig 20. A series of 2 transitional groynes are proposed. Groynes of lengths 180m and 140m are proposed. A filter layer of 1kg to 10kg category stone, Core layer using 100 to 300 kg stones, Toe Mound using 500 to 800 kg stones, Armour layer using 1.5T to 2.5T stones proposed here. In addition to that, 2T tetrapods of 1.96m Thickness and 4T tetrapods of 2.50m Thickness are provided for armour layer.

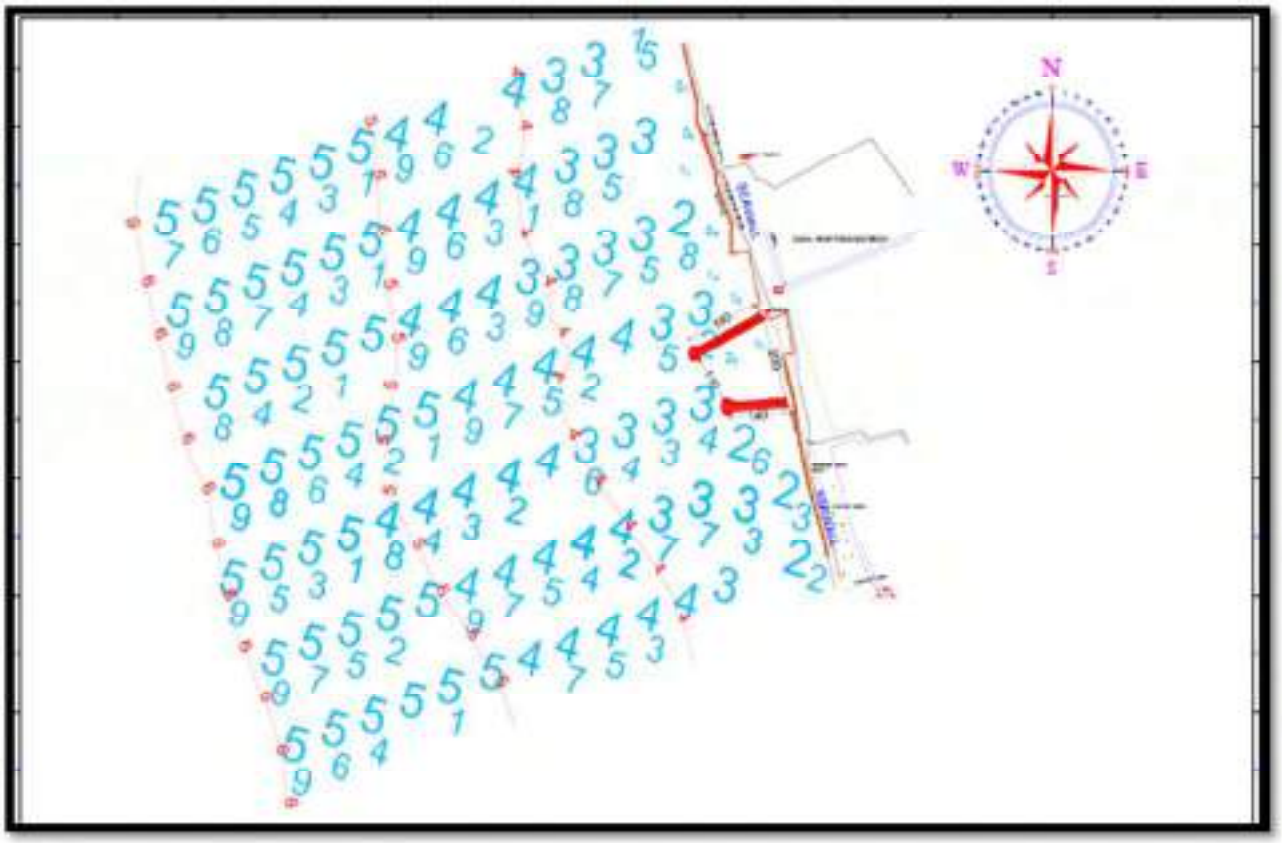


Fig-20- Layout- Pazhangadu

The geographical instability of the beach necessitates comprehensive shore protection measures to safeguard the area against erosion, tidal influences, and other environmental factors. However, the intricacy of the situation is further compounded by the remoteness of the location, characterized by the absence of a proper approach road. Given these challenges, the establishment of an FLC in this particular area is not deemed feasible.

It has been observed that only a limited number of fishermen, typically one or two, venture into the sea from this remote beach. Consequently, there arises a pivotal need for the stabilization of the beach itself. The primary objective of the proposed project in the particular area is to facilitate the formation of a stable and secure beach environment, addressing the unique challenges posed by the geographical instability of the area.

An amount of Rs. 20.87 crore is required for stabilizing the proposed beach and to facilitate the Fish Landing facilities at Pazhangadu beach in Vypin Munambam stretch of Ernakulam district. **(Estimate and plan attached as Annexure 5)**

4.5.6. Saidh Mohammed beach

This stretch of the coastline is identified as a fishing landing centre and it is already protected with seawall and groynes.

Image 13. Google image- Said Mohammed Beach

A proposal is made to extend the existing groynes for about 160 m in length (upto -3 m water depth) and construct a pair of groynes to form a fish landing centre with a base width of about 150 m as seen in Fig 23. A series of 2 transitional groynes are proposed. Accordingly, groynes of length 160m and 120m are proposed. A filter layer of 1kg to 10kg category stone, Core layer using 100 to 300 kg stones , Toe Mound using 500 to 800 kg stones , Armour layer using 1.5T to 2.5T stones proposed here. In addition to that 2T tetrapods at 1.96m Thick and 4T tetrapods at 2.50m Thick is provided for armour layer.

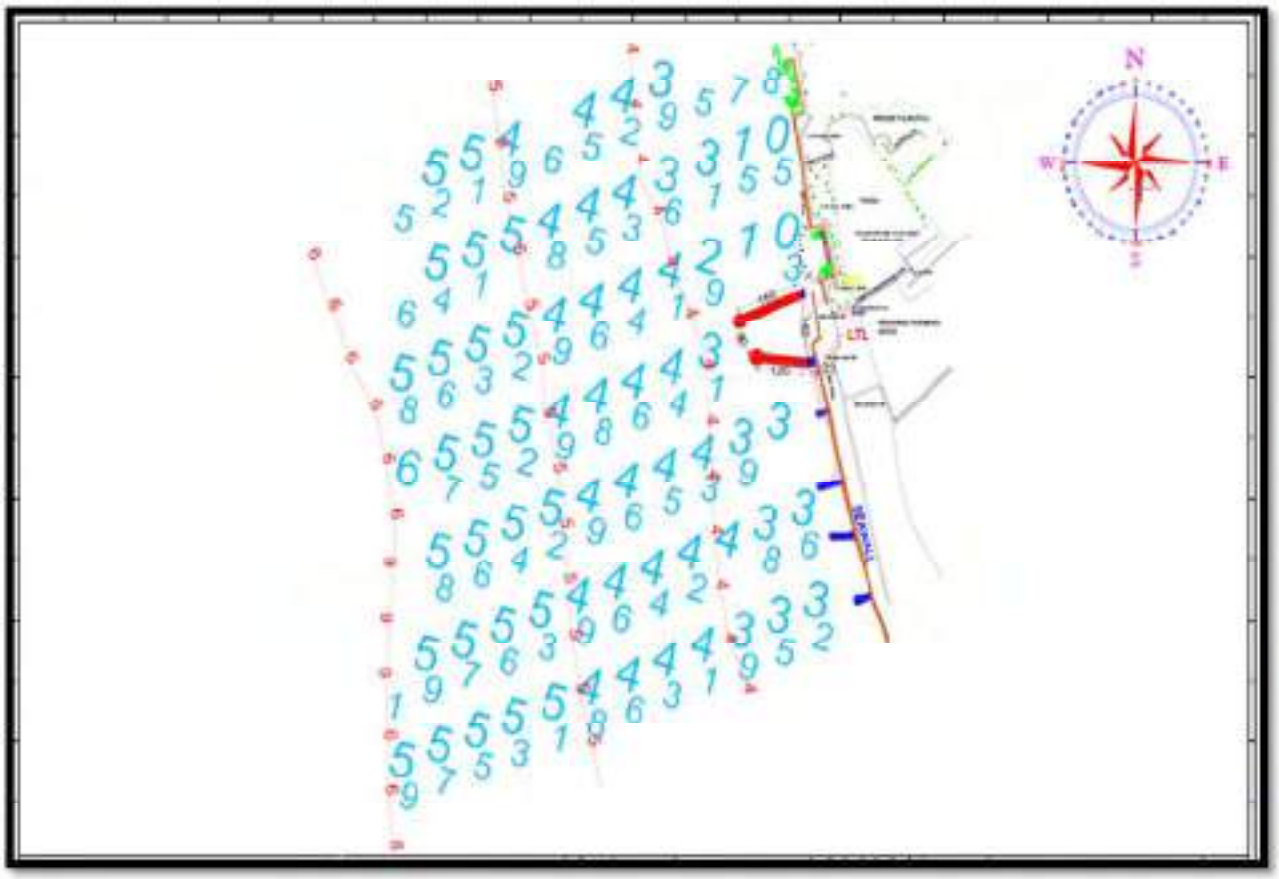


Fig-21- Layout- Said Mohammed Beach

An Auction hall of size 28.3m x 6.4m is proposed at Said Mohammed beach. Sufficient free land with road access is available for construction of fish landing centre at said Mohammed beach

For the auction hall, coconut piling of length 6m long is provided for foundation. RCC M20 provided for foundations, centering & shuttering, Reinforcement cement concrete work (M20) in walls is provided for super structure. Necessary Steel reinforcement, plastering and painting works are also included in the Auction hall. Provision for construction of a toilet block of size 12.5m x 5.1m is also included in the estimate. For the toilet block, RR masonry with cement mortar 1:6 is provided for the foundation. Solid block masonry of size 30x20x15cm and 40x20x10 cm are provided for super structure. Ceramic tiling is provided in the floor and in the bathroom region. Necessary fittings are also provided for toilet block. Other provisions include concrete parking area proposed near the Auction hall, construction of drain etc.

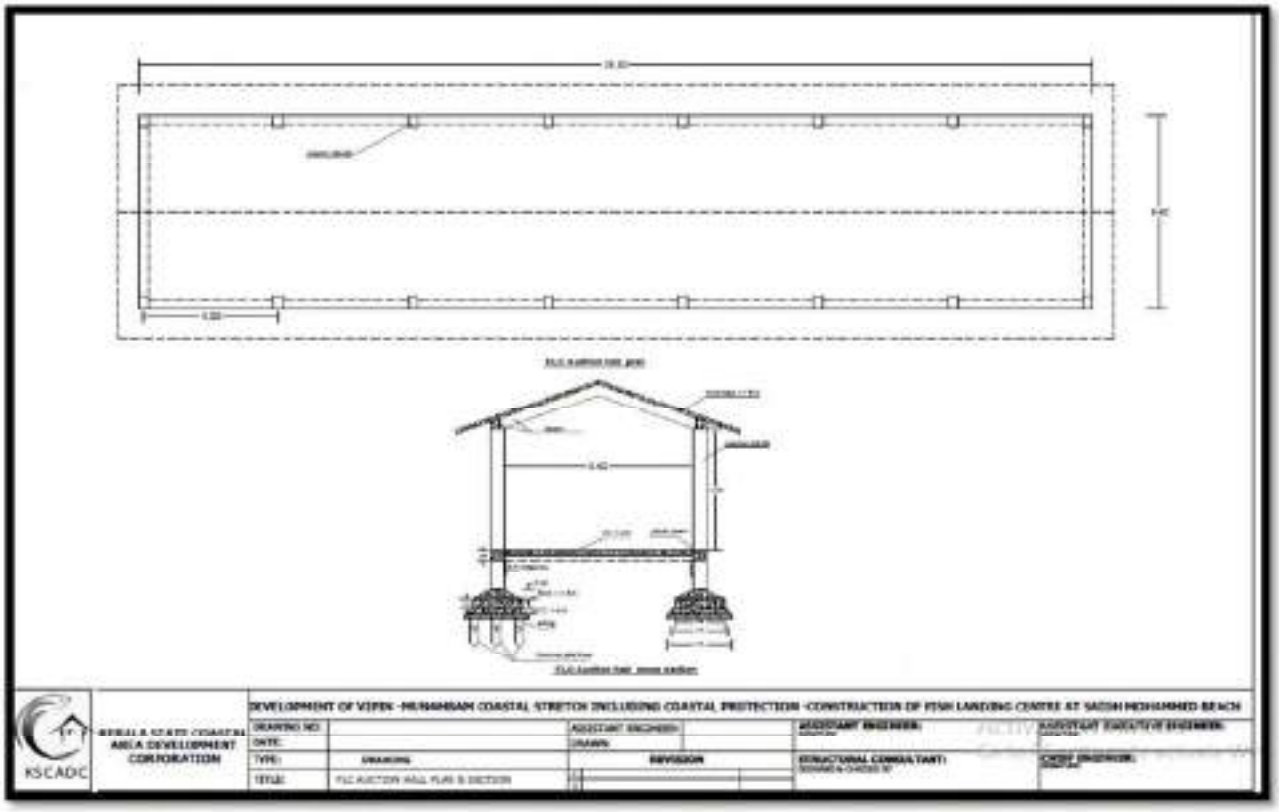


Fig-22- Auction hall, Said Mohammed Beach

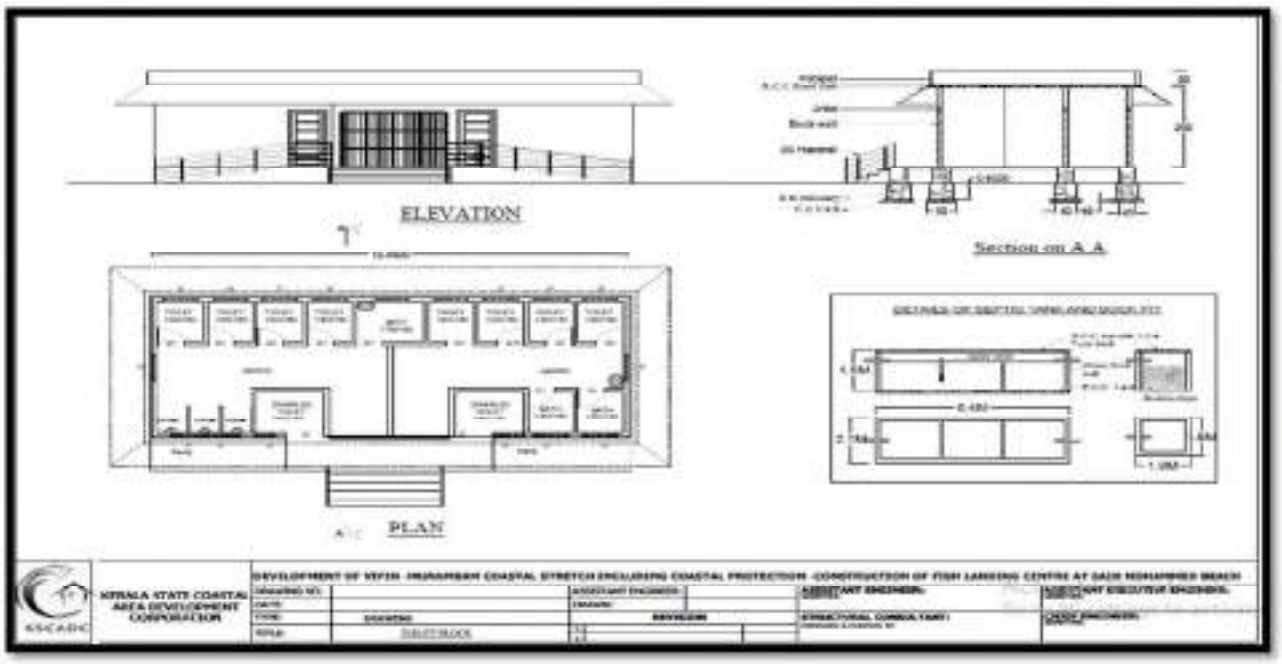


Fig-23- Toilet block, Said Mohammed Beach

An amount of Rs. 25.00 crore is required for construction of Modern Integrated Fish Landing facilities at Said Mohammed beach in Vypin Munambam stretch of Ernakulam district. **(Estimate and plan attached as Annexure 6)**

4.6. METHODOLOGY ADOPTED

4.6.1. Field Investigation

A detailed field investigation study was commissioned to collect real-time field data which includes shoreline mapping, beach profile and sediment characteristics. The study area from Vypin to Munambam was sub-divided into 6 major stretches for ease of executing field measurements the details of which alongside the geo-coordinates of each site are projected in Table 6.

Table 15.:- Co-ordinates of the site

S. No.	Place	Starting Point	Ending Point	Distance (km)
		Lat/Long	Lat/Long	
1	Valappu Beach	10°01'54.20" N 76°13'5.76" E	10°0'58.03" N 76°12'50.31" E	1.2
2	Elamkunnapuzha Beach	10°01'12.60" N 76°12'47.50" E	10°1'55.13" N 76°12'33.93" E	1.4
3	Njarackal Arattuvazhi Beach	10°02'15.76" N 76°12'28.03" E	10°2'57.56" N 76°12'16.72" E	1.3
4	Veliyatham Parambu Beach	10°03'3.99" N 76°12'12.54" E	10°3'57.93" N 76°11'54.87" E	1.8
5	Nayarambalam Puthan Kadappuram			
6	Edavankkadu Grama Panchayat	10°04'10.15" N 76°11'50.81" E	10°5'54.10" N 76°11'23.34" E	3.3
7	Pazhangadu			
8	Saidh Mohammed Beach			
9	Kuzhippilly	10°06'7.65" N 76°11'20.07" E	10°09'39.22" N 76°10'17.37" E	6.8
10	Pallipuram			
11	Cherai			
12	Arattu Kadavu Beach			

The science of shoreline mapping has significantly evolved over the years to reduce the uncertainties involved in measurement and data processing. The remotely collected data from satellite imagery, such as the Google Earth timeline imagery, can furnish valuable preliminary data to understand the dynamic behaviour of shoreline variation in a localized stretch. The comprehensive effect of shoreline changes can be understood by employing statistical approaches. The methodology adopted for the Model study includes data collection, shoreline demarcation, and shoreline change rate calculation. Multi-temporal satellite cloud-free data of Landsat TM and ETM sensors acquired from 2008 to 2020 along the Kerala Coast. The data source was used to demarcate the shoreline change using ArcGIS. The shoreline data analysis has been projected in Fig 24.

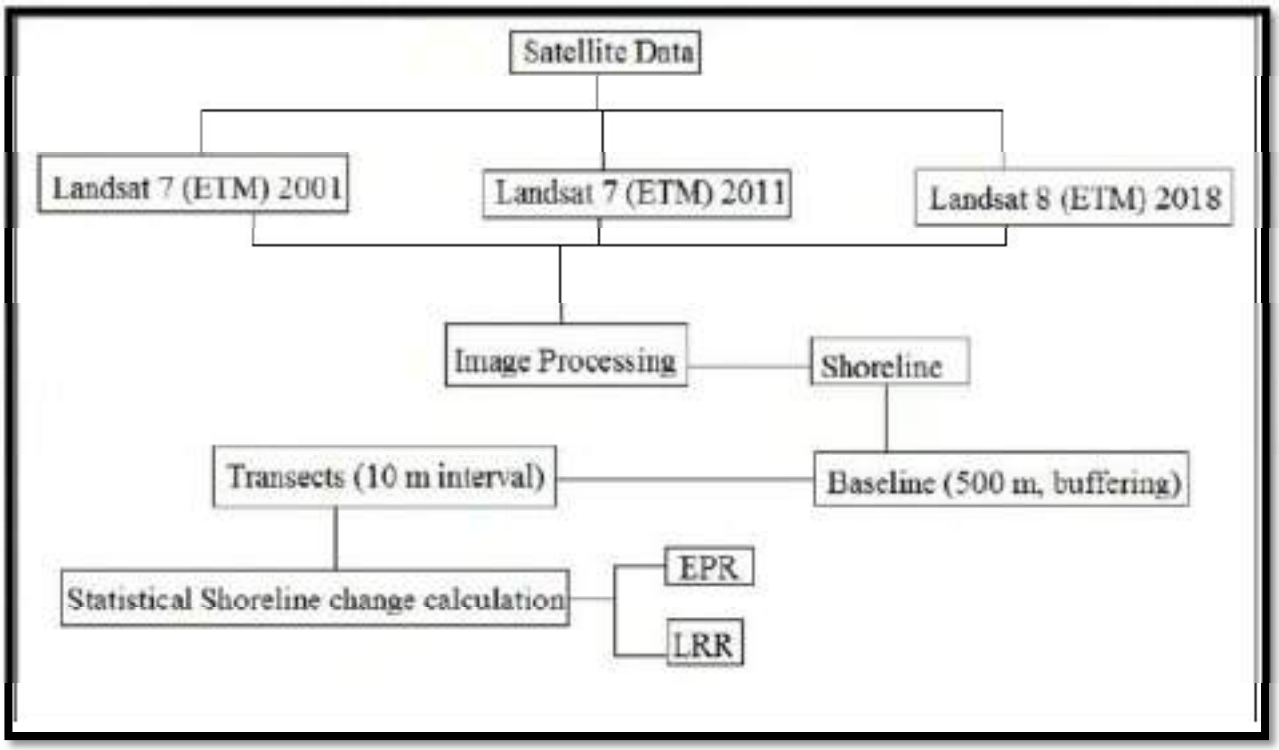


Fig 24. Flow chart for methodology

4.6.2. Topographic Survey

Beaches are extremely dynamic in nature experiencing continual changes in shape and shifting position with response to winds, waves, tides, relative sea level, and anthropogenic activities. The most significant changes occur due to seasonal changes in wave climate and during extreme events such as storm surge or cyclone events. The mapping of shoreline as well as demarcation of the existing seawall and groynes structures were measured using RTK GPS system. The beach profile at various transects for a given coastal stretch was also measured.

Navigation and data logging system includes 2 x Trimble R10 RTK GPS with Base and Rover accessories, 1 x Measuring Tape

4.6.3. Wave Modelling

An application of the spectral wave prediction model for the Arabian Sea has been carried out to evaluate the spectral wave parameters offshore off the Vypin to Munanbam for the planning of coastal protection. The global wave model is based on the "WAM" model has been adopted. This model simulates the evolution of two-dimensional ocean waves using the spectral energy balance equation, in which wave energies are balanced with the local wind input, wave dissipation and non-linear energy transfer. The coarser grid model has been executed over a regional domain, which includes the Indian Ocean, Bay of Bengal and the Arabian Sea. The finer grid model has been set up over the Arabian Sea with a focus along the south-west coast of India with boundary information from the coarse grid model. ECMWF wind vectors over an annual year have been obtained for the domain of interest and the wind-waves have been evaluated at a deep-water location off the study area as mentioned above. The near shore wave modeling that includes diffraction due to breakwaters caters for propagating deep water waves into the near shore. The littoral drift study transforms the deep-water wave climate into near shore normal wave characteristics.

4.6.4. Littoral Drift Estimate

The wave characteristics viz., significant wave height, mean wave period and mean wave direction at a deep-water location off Vypin to Munambam, at Valappu Beach, Elamkunnapuzha Beach, Njarackal Arattuvazhi Beach, Veliyatham Parambu Beach, Edavankkadu Grama Panchayat, Saidh Mohammed Beach, Kuzhippilly, Pallipuram Raktheswari beach, Cherai beach, Arattu Kadavu beach Kerala have been extracted at every 6 hours interval from the European Centre for Medium-Range Weather Forecasts (ECMWF).

4.6.5. Numerical Modelling for Shoreline Evolution

Structures in the near shore environment are built for different purposes, which may be for the formation of artificial harbors, shore protection measures, seawater intake systems, disposal of effluent, etc. There are several

configurations of such structures with respect to the shoreline, among which, structures normal to the shore are most common. The construction of a shore-connected structure often leads to changes in the shoreline. This warrants a study on the shoreline due to the presence of the shore-connected structures. Such a study is very much essential in the planning stage; so as to assess the impact of shore connected structures on the adjacent shoreline.

Numerical models offer the capability to study the effect of the wave characteristics, structure dimensions and other associated parameters in providing reasonable estimates of the shoreline response. As the ocean waves approach the near shore it undergoes transformations like shoaling, refraction, diffraction and breaking. The phenomena of wave breaking throw sediments to the surface due to the turbulence generated. The sediments in suspension are then driven by the wave-induced currents. Since the direction of waves in the near shore is oblique, the currents induced by them have two components. One along the shore called the long shore current is mainly responsible for the long shore sediment transport, which plays an important role in the shoreline changes especially due to the shore connected structures. The other component is in the direction normal to the shore, in which case, the mode of sediment transport is called onshore-offshore sediment transport. When a structure normal to the shoreline is constructed, it will intercept the free passage of long shore sediment transport, which results in an imbalance in the quantity of sediment on the near shore, especially near the structure. This leads to accretion on the up-drift side and erosion on the down drift side of the structure.

CHAPTER 5. FINANCIAL ESTIMATES AND COST PROJECTIONS

5.1. FINANCIAL OUTLAY

The major components of work are construction of fish landing facilities and supply and installation of the Geo tubes and groynes The estimate for these items is done based on the rate analysis prepared for the supply of materials, construction and installation charges. A special data was worked out based on the actual site conditions and prevailing market rates.

The estimate for the civil works is prepared based on DSR 2018 and Cost Index of 35.59 % using the PRICE software. The total project cost works out to **Rs. 145.87 crore (Rupees One hundred and forty five crore and eighty seven lakh only).** (Details in Table 22).The expenditure will be phased over a period of 2 years from the date of commencement.

The detailed estimate and abstract prepared in PRICE software is attached. Consultancy charges payable to the PMC, taxes and other statutory expenses are included in the cost abstract. The abstract of each landing centre is given in table 16 to table 21

Table 16. Financial Outlay of Modern Integrated Fish landing facilities at Valappu Beach

Sl No	Project Components	Total Financial Outlay (in Rs.)
1	Supplying and placing of geosynthetic tubes	15 48 97 319/-
2	Construction of Auction Hall	31 90 663/-
3	construction of Toilet block	24 10 666/-
4	construction of Parking Area	78 60 744/-
5	Construction of Drain	11 44 187/-
6	Seawall Strengthening	2 00 00 000/-
7	Sub soil investigation	15 00 000/-
8	Water supply and sanitary arrangement	25 00 000/-
9	Electrification and yard lighting	15 50 000/-

10	Unforeseen expenses @ 2.5%	49 00 000/-
11	Sub Total	19 99 53 579/-
12	GST @ 18%	3 59 91 644/-
13	Total Amount including GST 18%	23 59 45 223/-
14	Lumpsum for Round off	54 777/-
15	Total Amount	23 60 00 000/-
16	Consultancy @5%	1 18 00 000/-
17	GST on consultancy @ 18%	R21 24 000/-
18	Round off	76 000/-
	Grand Total	**Rs 25 00 00 000/-**
Rupees Twenty Five Crore Only		

Table 17. Financial Outlay of Modern Integrated Fish landing facilities at Malipuram Beach

Sl No	Project Components	Total Financial Outlay (in Rs.)
1	Groyne	18 13 68 224/-
2	Construction of Auction hall	31 99 195/-
3	Construction of Toilet block	22 56 232/-
4	Parking Area	39 04 172/-
5	Drain	11 81 928/-
6	Sub soil investigation	10 00 000/-
7	Water supply and sanitary arrangement	11 00 000/-
8	Electrification and yard lighting	10 00 000/-
9	Unforeseen expenses @ 2.5%	49 40 000/-
10	Sub Total	19 99 49 752/-
11	GST @ 18%	3 59 90 955/-
12	Total Amount including GST 18%	23 59 40 707/-
13	Lumpsum for Round off	59 293/-
14	Total Amount	23 60 00 000/-
15	Consultancy @5%	1 18 00 000/-
16	GST on consultancy @ 18%	21 24 000/-
17	Round off	76 000/-
18	**Grand Total**	**Rs.25 00 00 000/-**
	Rupees Twenty Five Crore Only	

Table 18. Financial Outlay of Modern Integrated Fish landing facilities at Valiyathamparambu

Sl No	Project Components	Total Financial Outlay (in Rs.)
1	Groyne	17 75 05 385/-
2	Construction of Auction Hall	31 90 663/-
3	construction of Toilet block	24 10 666/-
4	construction of Parking Area	63 36 782/-
5	Construction of Drain	11 44 187/-
6	Sub soil investigation	15 00 000/-
7	Water supply and sanitary arrangement	19 00 000/-
8	Electrification and yard lighting	10 00 000/-
9	Unforeseen expenses @ 2.5%	49 90 000/-
10	Sub Total	19 99 77 684/-
11	GST @ 18%	3 59 95 983/-
12	Total Amount including GST 18%	23 59 73 667/-
13	Lumpsum for Round off	26 333/-
14	Total Amount	23 60 00 000/-
15	Consultancy @5%	1 18 00 000/-
16	GST on consultancy @ 18%	R21 24 000/-
17	Round off	76 000/-
18	**Grand Total**	**Rs. 25 00 00 000/-**
	Rupees Twenty Five Crore Only	

Table 19. Financial Outlay of Modern Integrated Fish landing facilities at Puthenkadappuram

Sl No	Project Components	Total Financial Outlay (in Rs.)
1	Groyne	15 18 22 781/-
2	Construction Of Auction Hall	31 90 663/-
3	construction of Toilet block	24 10 666/-
4	construction of Parking Area	78 60 744/-
5	Construction of Drain	11 44 187/-

6	Seawall Strengthening	2 36 00 000/-
7	Sub soil investigation	15 00 000/-
8	Water supply and sanitary arrangement	25 00 000/-
9	Electrification and yard lighting	10 00 000/-
10	Unforeseen expenses @ 2.5%	49 00 000/-
11	Sub Total	19 99 29 041/-
12	GST @ 18%	3 59 87 227/-
13	Total Amount including GST 18%	23 59 16 268/-
14	Lumpsum for Round off	83 732/-
15	Total Amount	23 60 00 000/-
16	Consultancy @5%	1 18 00 000/-
17	GST on consultancy @ 18%	21 24 000/-
18	Round off	76 000/-
19	**Grand Total**	**Rs.25 00 00 000/-**
Rupees Twenty Five Crore Only		

Table 20. Financial Outlay of Modern Integrated Fish landing facilities at Pazhangadu

Sl No	Project Components	Total Financial Outlay (in Rs.)
1	Groyne	16 18 89 405/-
2	Yard lighting	1000000/-
3	Unforeseen expenses @ 2.5%	4000000/-
4	Sub Total	166889405/-
5	GST @ 18%	30040093/-
6	Total Amount including GST 18%	196929498/-
7	Lumpsum for Round off	70502/-
8	Total Amount	197000000/-
9	Consultancy @5%	9850000/-
10	GST on consultancy @ 18%	1773000/-
11	Round off	77000/-
	Grand Total	**Rs.208700000/-**
Rupees Twenty Crore and Eighty Seven lakh Only		

Table 21. Financial Outlay of Modern Integrated Fish landing facilities at Said Mohammed Beach

Sl No	Project Components	Total Financial Outlay (in Rs.)
1	Groyne	14 11 98 972/-
2	Construction of Auction Hall	31 90 663/-
3	construction of Toilet block	24 10 666/-
4	construction of Parking Area	78 60 744/-
5	Construction of Drain	11 44 187/-
6	Seawall Strengthening	3 25 00 000/-
7	Sub soil investigation	19 00 000/-
8	Water supply and sanitary arrangement	25 00 000/-
9	Electrification and yard lighting	23 00 000/-
10	Unforeseen expenses @ 2.5%	49 50 000/-
11	Sub Total	19 99 55 232/-
12	GST @ 18%	3 59 91 942/-
13	Total Amount including GST 18%	23 59 47 174/-
14	Lumpsum for Round off	52 826/-
15	Total Amount	23 60 00 000/-
16	Consultancy @5%	1 18 00 000/-
17	GST on consultancy @ 18%	21 24 000/-
18	Round off	76 000/-
19	**Grand Total**	**Rs. 25 00 00 000/-**
Rupees Twenty Five Crore Only		

Table 22- Total Financial Outlay

Sl No	Name of component	Amount (Rs. in Crore)
1	Modern Integrated Fish landing facilities at Valappu Beach	25.00
2	Modern Integrated Fish landing facilities at Malipuram	25.00
3	Modern Integrated Fish landing facilities at Valiyathamparambu	25.00

4	Modern Integrated Fish landing facilities at Puthenkadappuram	25.00
5	Modern Integrated Fish landing facilities at Pazhangadu	20.87
6	Modern Integrated Fish landing facilities at said Mohammed Beach	25.00
	Grand Total	**145.87**

5.2. MEANS OF FINANCE

An amount of **Rs 145.87 Crore (Rupees One hundred and forty five crore and eighty seven lakh only)** is required for the proposal "Modern Integrated Fish Landing Facilities in the coastal stretch of Vypin to Munambam in Ernakulam district". The proposal is suggested to be implemented under " Non- Beneficiary Oriented Activities under Centrally Sponsored Components of Pradhan Mantri Matsya Sampada Yojana, B. Infrastructure and Post Harvest Management, 3. Development of Fishing Harbours and Fish Landing Centres 3.3. Modern Integrated Fish Landing Centres

Table 23. Funding Pattern

Total Financial Outlay (Rs. in crore)	CSS Share under PMMSY (Rs. in crore) (60%)	State Share (Rs. in crore) (40%)
145.87	**87.522**	**58.348**

5.3. REVENUE STREAMS AND BENEFITS OF THE PROJECT

The revenue streams and benefits associated with the project are multifaceted, encompassing both social and environmental dimensions. The primary focus of the project is to enhance fish activities in the designated area, thereby augmenting the number of fishing mandays. This, in turn, is expected to substantially boost the day-to-day revenue of the marginalized fishing community residing along the Vypin-Munambam stretch.

One of the paramount benefits of the project lies in the safeguarding of public property, including crucial infrastructure such as roads and residences. By providing effective shore protection, the project mitigates the risk of damage to these vital assets, ensuring the overall resilience and longevity of public infrastructure.

A significant outcome of the project is the creation of an expansive beach with an estimated average width of 40 meters along the entire stretch where shore protection is proposed. This widened beach not only enhances the aesthetic appeal of the coastal area but also serves a practical purpose. It provides an ideal landing site for local fishermen to bring in their fishing crafts, offering proximity to their residences. This strategic aspect of the project is designed to prevent the price slashing of landed fish and mitigate potential social issues arising from fishermen of one village landing their crafts in another village's landing center.

While conventional financial metrics such as returns and cost-benefit analysis may not be directly applicable due to the project's classification as a social project, the tangible social benefits are evident. The project stands as a catalyst for community development, fostering economic empowerment within the marginalized fishing community.

In addition to the social benefits, the project contributes significantly to environmental conservation. The adoption of an eco-friendly approach to shore protection, avoiding the use of quarry stones, exemplifies a commitment to sustainable practices. The utilization of sand dredged from the sea to fill Geo bags aligns the project with environmentally conscious strategies, minimizing the ecological impact.

Simultaneous beach nourishment initiatives further enhance the environmental benefits, actively preventing erosion on nearby beaches and ensuring the overall stability of the coastal ecosystem. The offshore breakwater structure, as highlighted by the National Institute of Ocean Technology (NIOT), is

anticipated to function as an artificial reef, providing a conducive breeding ground for diverse species of fishes.

In summary, the revenue streams and benefits of the project are diverse and impactful, spanning economic, social, and environmental dimensions. By fostering increased fishing activities, protecting public property, creating a functional and aesthetically pleasing beach, and adopting eco-friendly shore protection measures, the project emerges as a comprehensive and transformative initiative with enduring positive effects on the local community and the coastal environment.

5.4. COST BENEFIT ANALYSIS

The fish landing centers and related infrastructures primarily serve poor fishermen communities and have a strong service-oriented focus, they can also yield substantial economic benefits for the broader community and the region as a whole. The economic analysis of such projects often reveals their potential for high returns on investment.

1. **Economic Impact Beyond Direct Beneficiaries:** While the primary objective of these projects is to support local fishermen, the positive economic impact extends beyond the fishing community. Improved infrastructure and services can attract additional economic activities, such as processing, transportation, and tourism, which can benefit the entire region.
2. **Reduced Post-Harvest Losses:** Modern fish landing centers and associated facilities, including facilities to reduce post-harvest losses. This means more of the catch reaches the market in optimal condition, increasing the overall economic value of the fishing industry.
3. **Stimulating Local Economies:** The construction and operation of these facilities generate employment opportunities, both directly in the fishery sector and indirectly through support services. This can lead to higher income levels and improved standards of living for the local population.

4. **Tourism and Trade:** Upgraded infrastructure can attract tourists, traders, and investors to the area, further contributing to economic growth. Enhanced facilities often result in increased economic activity related to tourism and trade.
5. **Long-Term Environmental Benefits:** Sustainable fishing practices can help maintain the health of the marine ecosystem, preserving it as a valuable resource for the future. A healthy ecosystem can support long-term economic sustainability.
6. **Social Well-being:** While not always captured in economic analyses, improving the well-being and quality of life for the fishing community has social and economic implications. Healthier, economically stable communities are better positioned to contribute positively to the local economy.

In light of these factors, it is not uncommon for the economic analysis of fish landing centers and related infrastructure projects to demonstrate their high economic viability, especially when considering their multifaceted impact on the community and regional development. Furthermore, such projects often align with broader sustainable development goals by promoting economic growth, environmental sustainability, and social well-being in the region.

However if an economic analysis is carried out for any fishery related infrastructure or the like, the cost benefit accrued will be highly promising.

Considering the resources potential of the area, investment proposal of the project is found to be economically viable.

5.5. RISK ASSESSMENT AND MITIGATION MEASURES

Project implementation schedule and proven construction management strategy are in place to reduce the probability and impact of risks in the proposed project. The following Risks are identified in the project and the responses to each are explained along with.

i. **Climatic conditions:** The work is to be done in the open sea where aggressive wave climate exists. Generally, the fair-weather season is from October to

April. All the installation works are to be done during this short span of time. Even during this season there may be rough sea conditions occurring during spring tides, atmospheric depressions etc. Such changes may cause delay in completion of the work.

ii. **Cash Flow issues:** Only pre-qualified contractors' bids shall be opened to assure that only solvent contractors are awarded the work. Proactive action shall be taken to plan the financial progress and to get the funds in advance to avoid delays

iii. **Schedule of Rates Revision:** Revision of schedule of rates between the times of formulating the project to time of tendering may lead to tender excesses. Contingency reserve is made in the estimate to cover this risk.

iv. **Sea bed level variations during execution**: It is obvious that any structure that constructed in the sea may cause bathymetric changes, This has to be addressed by the artificial nourishment methods.

v. **Stoppage of work in Monsoon:** No work in the open sea is possible during May to September. During this time the dredgers barges etc.have to be moved to a safe tranquil basin.

vi. **Natural hazards**: Cyclones and surges may result in displacement and damage of the Geo tubes, which are anchored and placed under water for filling. Daily warnings from the meteorological department are received at selected email addresses of departmental officers now to take preventive action in the case of rough sea conditions.

vii. **Unexpected Technical issues** Assumptions made during formulation of the project are also sources of risks. Coastal processes involve many variables and heterogeneous environments. Bathymetry of the sea bed, shore lines, wave climate, wind data etc are used to run the models. Major changes in any of these variables may lead to changes in results of the model and the prototype. Models are run on the surveys and data collections made at the time of model study results to avoid risk originating from this source. In such cases, bathymetric and shoreline changes are being mapped on regular intervals and there is a project office at the project location itself to monitor any changes in the above variables. The project of construction of offshore

breakwater using Geo Tubes is the first of its kind, being implemented in the state. Hence being an experimental project there may be practical issues coming across during implementation. To address the issues timely an expert committee will be constituted, and they will provide timely solutions to the issues.

CHAPTER 6. PROJECT IMPLEMNTATION

6.1. PROJECT MANAGEMENT ORGANIZATION

Kerala state Coastal Area Development Corporation, Government accredited agency will be the implementing organization

Preparation of detailed design, drawings, estimates and issue of Technical sanction will be done by Kerala State Coastal Area Development Corporation (KSCADC) as per the existing government guidelines applicable to Government Accredited Project Management Consultancies. KSCADC, a fully government owned corporation will be responsible for implementation of the present project. KSCADC will ensure that the Project's development objectives are achieved timely and efficiently.

KSCADC is equipped with an expert team of Engineering wing which includes Chief Engineer, Executive Engineers, Assistant Executive Engineers, Assistant Engineers (Civil), Assistant Engineers (Electrical) and Overseers. Structural Engineer and Architects are also working in the team. A project wing and administrative wing also functions at KSCADC which will ensure the completion of projects in all aspects in the stipulated time period.

The tendering process will be initiated by KSCADC once the Administrative Sanction is accorded. Relevant tenders will have Pre-Qualification verification by PQ committee. The tenders will be floated with the General conditions of contract, as per the prevailing PWD guidelines. The Chief Engineer, KSCADC will be the agreement authority.

With regard to the implementation of the works, Kerala State Coastal Area Development Corporation Limited will ensure participation of all line departments like Local Self Governments, Tourism, Culture, Fisheries, HED for the effective and time bound implementation of the proposed project. Handholding support will be ensured from national institutes like IIT, Madras, NIOT, CPWRS etc.

The KSCADC will henceforth undertake the following roles:

- Overall management for improved and sustainable development, including monitoring and evaluation of activities, outcomes and impacts.
- Support the development and management of existing common infrastructure, with improved financial and operational performance.
- Planning and construction of the integrated project with active participation of user groups, LSGs and line departments.
- Arranging social, technical, management and capacity building support.

In addition to overall programme planning and management, the KSCADC will be responsible for:

- setting up and guiding the functioning of the Project Management unit.
- consolidation of work plans
- consolidation of periodic progress report
- liaison with GOK and the funding agency
- financial management and audit
- human resource development, including hiring of specialists
- fund flow management and fund releases
- procurement of goods, works and services
- overseeing implementation of the environmental management framework
- monitoring, learning, impact evaluations and MI
- quality control of works and processes.

The unexpected technical issues during execution if any, will be addressed timely and solutions will be provided without any delay. For this a high-level technical committee will be constituted. The committee will have include representatives from Department of Fisheries, from KSCADC and an expert from the Model study agency or any other reputed national Institute, and also an expert nominated by the Contractor.

6.2. CONTRACT MANAGEMENT STRATEGY

The Public Works manual approved by the state government specifies the duties, responsibilities and delegated powers of officers in contract management. It also specifies fines for project delays and incentives for early completion. The implementing department / KSCADC has approved delegated powers for inviting tenders and contract management. The Chief Engineer KSCADC is the tendering and contract signing authority in the case of projects of this magnitude. Prequalification tenders in two-cover system are invited for works having a value greater than Rs. 5.0Cr. Selection of qualified bidders is made by a pre-qualification committee. Tenders will be accepted as per the prevailing guidelines for acceptance of tenders. As this particular nature of work is not covered under the CPWD specifications, the specifications and design proposed by the model study agency is taken for estimation. Any way alternate designs will also be accepted from the bidders to have a better cost optimization. These designs shall be verified and approved by a premier institution acceptable for the evaluation committee.

The general conditions of contract have to be modified to some extend as this is a work of special nature. The tender evaluation committee will be examined and approved the tender conditions.

Contract management pertaining to technical specifications are supervised and managed by engineers and overseers assigned to the project. Contractors' payments are controlled by the KSCADC office. Divisional accounts officer posted at the KSCADC HQ and Senior Finance Officer will audit the contractors' bills prior to making payments

The Operation and Management of the completed works and observation of defects during defect liability period will be supervised by the Assistant Engineer. Operation and Management of the completed works and observation of defects during defect liability period will be also supervised by the Assistant Engineer.

6.3. IMPLEMENTATION SCHEDULE AND WBS

A detailed WBS and program of work shall be formulated on real time basis on scheduling software during the technical sanction procedure to finalize the baseline schedule. At present it is estimated that a period of 24 months is required for the implementation of the work. Tentative schedule is given in Table

Table 24- Implementation Schedule

Sl No	Task	1st Year												2nd Year											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1	Approval of Project by GOI																								
2	State Government Level Approval and issuance of Administrative Sanction																								
3	Issuance of Technical Sanction for the works																								
4	Obtaining of Mandatory documents																								
5	E-tender process																								
6	Evaluation and approval of tender																								
7	Issuance of Selection Notice/ work order/ execution of agreement																								
8	Acquiring of proposed land for construction purpose																								
9	Commencement of deployment of groins, geotubes, construction of Fish landing centre																								

10	Progress of Civil and Electrical works																							
11	Installation of Ancillary items																							
12	Final completion																							
13	Official handing over of the completed works for commissioning																							
14	Functioning of Fish Landing Centres																							

6.4. STATUTORY CLEARANCES & IMPACT ASSESSMENTS

Fish landing facilities and Shore protection works, vital for empowering the marginalized fishermen community and safeguarding coastal areas, are recognized as permissible activities under the Coastal Regulation Zone (CRZ) guidelines. Despite this recognition, a crucial procedural step involves obtaining clearance from the state Coastal Zone Management Authority (CZMA). This necessary clearance from the CZMA becomes an immediate priority upon the receipt of Administrative Approval for the shore protection project.

To ensure expeditious progress and timely initiation of the project, a proactive approach will be adopted. The tendering process, a pivotal step in selecting contractors and finalizing project details, will be set into motion concurrently with the application for CRZ clearance. This parallel execution of the tendering process and the CRZ clearance procedure is strategically designed to eliminate unnecessary delays that might otherwise impede the implementation of the project.

By undertaking these processes concurrently, the aim is to streamline administrative procedures, optimize efficiency, and expedite the project timeline. This synchronized approach not only minimizes bottlenecks but also reflects a commitment to prompt and effective project execution, thereby contributing to the timely enhancement of coastal resilience and protection.

In essence, the concerted effort to secure CRZ clearance in tandem with the tendering process underscores a commitment to a seamless and efficient project implementation framework. This approach not only adheres to regulatory requirements but also exemplifies a strategic and proactive stance, ensuring that shore protection works are initiated without undue delay, ultimately contributing to the sustainable development and protection of coastal regions.

6.5. QUALITY MANAGEMENT PLAN

In the state, the implementation of all public works is meticulously governed by the Quality Manual, a document that has received official approval from the government. This comprehensive manual serves as the beacon for guiding the execution of diverse projects, delineating explicit quality control measures tailored to the specific requirements of each type of work. Furthermore, it allocates and fixes responsibility for ensuring the quality of project works across different levels within the organizational hierarchy.

Underpinning this commitment to quality is the establishment of a robust three-tier quality control system, a pivotal component of the overarching quality management plan. This strategic approach is geared towards upholding and safeguarding the integrity of public works through a multi-faceted quality assurance framework.

To operationalize this system, a Government-approved quality control laboratory will play a pivotal role in executing rigorous quality control measures. Additionally, collaboration with esteemed National Institutions, such as IIT Madras and NIOT, forms the bedrock of the second tier of quality control. These institutions will act as a regional quality control wing, meticulously overseeing and evaluating the quality of project execution to ensure compliance with established standards.

Adherence to the Public Works Department (PWD) circular for quality control is paramount in upholding the high standards set forth in the Quality Manual. The circular serves as a guiding document, and the responsibility for implementing the first tier of quality control is vested in the capable hands of

Assistant Engineers and Assistant Executive Engineers who operate at the project level.

Going beyond internal controls, the third tier of quality control involves an additional layer of scrutiny. Specifically, the quality of materials, such as geotubes and stones used in breakwater construction, will undergo verification at third-party laboratories. This verification process, undertaken at the expense of the contractors, ensures an unbiased and objective assessment of the materials' quality.

In summation, the state's commitment to quality in public works is not merely a procedural formality but a comprehensive and systematic approach. By integrating the guidelines outlined in the Quality Manual, collaborating with national institutions, and implementing multi-tiered quality control mechanisms, the state endeavors to deliver public projects that stand as benchmarks of excellence. The attached circular provides a detailed roadmap for stakeholders, reinforcing the commitment to uncompromising quality standards in public infrastructure development.

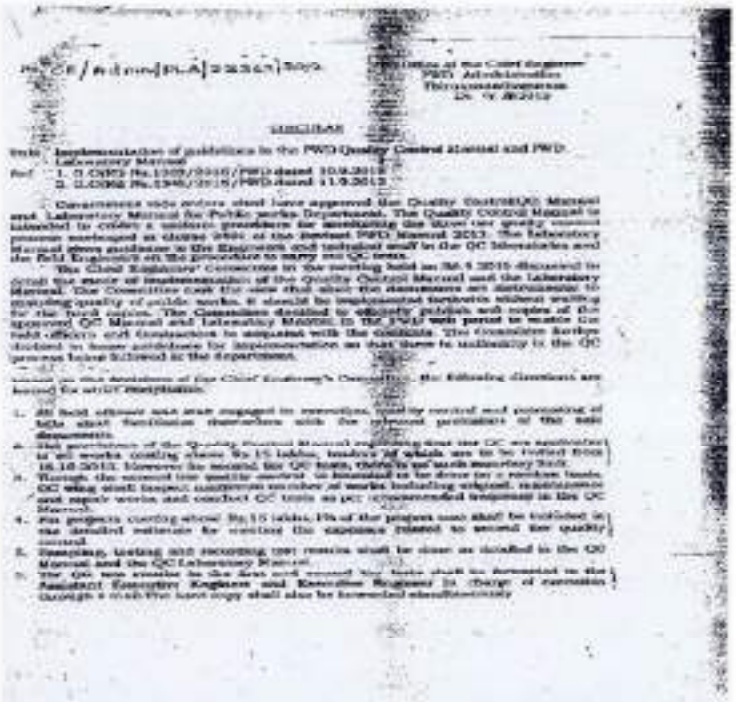


Image 14 State Quality Control circular

6.6. OPERATION AND MAINTENANCE

The proposed fish landing facility and shore protection works are envisaged to be exceptionally durable, requiring minimal major maintenance for a substantial period spanning between 10 to 15 years. This longevity is a testament to the robust engineering and construction methodologies incorporated into the project, ensuring its resilience against the coastal elements.

A noteworthy facet of the project is the concurrent proposal for beach nourishment, a process integral to maintaining and enhancing the coastal environment. As part of this initiative, beach rebuilding activities will be undertaken in the designated area. Consequently, there will be a reduction in water depth, accompanied by a decrease in incident wave height. To counterbalance these changes, an off-shore breakwater will be strategically implemented. The installation of the off-shore breakwater serves a dual purpose: not only does it contribute to the protection of the shore, but it also fosters the creation of a sustainable beach. This carefully designed intervention is anticipated to preserve the natural dynamics of the coastal area, ensuring its integrity and stability for an extended period, projected to be not less than 15 years.

Recognizing the importance of environmental conservation, a green cover will be conscientiously maintained in the area surrounding the fish landing facility and shore protection works. This strategic inclusion of vegetation plays a vital role in stabilizing the beach ecosystem, contributing to its resilience and long-term sustainability.

While the project is anticipated to require minimal major maintenance, any minor periodic maintenance works that may arise will be the responsibility of the concerned Local Self Government. This decentralization of maintenance responsibilities ensures a swift and localized response to any emerging maintenance needs, fostering a proactive approach to preserving the functionality and structural integrity of both the fish landing facility and the shore protection structures.

The comprehensive approach to the proposed project not only emphasizes its durability and sustainability but also underscores a commitment to environmental preservation. The incorporation of beach nourishment, off-shore breakwater, and a green cover signifies a holistic strategy aimed at creating a resilient and lasting coastal infrastructure. The proactive involvement of the Local Self Government in maintenance activities further ensures the prolonged effectiveness of the fish landing facility and shore protection works.

6.7. OUTPUTS & OUTCOMES

The "Modern Integrated Fish Landing Facilities in the Vypin Munambam Coastal Stretch" project, with its multifaceted approach, is expected to deliver a range of outputs and outcomes that will positively impact the local fishing community, the environment, and the regional economy.

Outputs:

- **Construction of Fish Landing Center**: The project will result in the establishment of a modern fish landing center equipped with safe and efficient infrastructure for fishermen to offload their catch.
- **Auction Hall**: An auction hall will be constructed, providing a centralized marketplace for the sale of fish, enhancing transparency and efficiency in the trading process.
- **Sea Wall Strengthening**: Strengthening the sea wall will provide coastal protection, reducing the risk of erosion and flooding and safeguarding the infrastructure from damage.
- **Toilet Blocks**: The project includes the construction of sanitation facilities, enhancing the working conditions and hygiene for the fishing community and visitors.
- **Drainage Improvements**: Drainage enhancements will prevent waterlogging and improve the overall cleanliness of the area.

- **Shore Protection Activities:** Shore protection measures, such as the deployment of groins and geotubes, will mitigate coastal erosion and enhance the resilience of the shoreline.

Outcomes:

- **Economic Empowerment**: The improved infrastructure, including the fish landing center and auction hall, is expected to increase the income of the local fishing community by providing better marketing opportunities and fair prices for their catch and major increase in the fishing mandays.
- **Environmental Sustainability**: The project's focus on shore protection and sustainable fishing practices contributes to the long-term preservation of the marine ecosystem in the Vypin Munambam coastal stretch, ensuring a healthier environment for future generations.
- **Infrastructure Resilience**: The strengthening of the sea wall and shore protection activities enhances the resilience of the coastal area, reducing the risks associated with erosion and flooding.
- **Improved Quality of Life:** The construction of sanitation facilities and drainage improvements enhances the overall quality of life for the local community. This includes better working conditions and a cleaner environment.
- **Economic Growth**: The modernized facilities are expected to stimulate economic activity in the region, generating income and job opportunities, supporting local businesses, and attracting tourism and trade.
- **Social Well-being:** The project has the potential to create a stronger sense of community, improved access to sanitation, and safer working conditions, contributing to the social well-being of the local population.

In summary, the project's outputs and outcomes are interlinked and collectively aim to enhance the economic prospects, environmental sustainability, infrastructure resilience, increased fishing man days and overall quality of life in the Vypin Munambam coastal stretch. It represents a holistic approach to

fostering positive change in the region, addressing the needs of the fishing community, the environment, and the broader community.

MANAGING DIRECTOR

ANNEXURES

ANNEXURE 1

Name of work : DEVELOPMENT OF VYPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION- CONSTRUCTION OF FISH LANDING CENTRE AT VALAPPU BEACH

ESTIMATE REPORT

The estimate for the construction of Fish Landing Centre at Valappu is prepared based on the study conducted by IIT Madras in the shore protection works from Vtypin to Munambam stretch in the Coastal Area of Ernakulam District.The stretch extends for 1.5 km and is observed to have a beach width of about 25m and it is located immediately north of the IOCL facilities. The beach slope is found to be very steep and it is understood that the beach width oscillates depending on the wave climate/seasons. Based on the satellite imagery studies conducted, this site has been observed to undergo moderate erosion rates. The cross-shore sediment transport is found to be significant during south-west monsoon season. In the estimate, a combination of 6 submerged geotubes of 3m dia of 820m length at a distance of 1600m from the shore line is proposed. This offshore submerged geo-tube is proposed to be erected at -5m water depth. It is laid over a filter layer of 1kg to 10kg stone and covered using geotextile mattress. Provision for Auction hall buidling of size 28.3m x 6.4m is included in the estimate. For the auction hall, coconut piling of length 6m long is provided for foundation. RCC M20 provided for foundations, centering & shuttering, Reinforcement cement concrete work (M20) in walls is provided for super structure. Necessary Steel reinforcement, plastering and painting works are also included in the Auction hall. Provision for construction of a toilet block of size 12.5m x 5.1m is also included in the estimate. For the toilet block, RR masonry with cement mortar 1:6 is provided for the foundation.Solid block masonry of size 30x20x15cm and 40x20x10 cm are provided for super structure. Ceramic tiling is provided in the floor and in the bathroom region. Necessary fittings are also provided for toilet block. Other provisions in the estimate include concrete parking area proposed near the the Auction hall. Provision for the construction of drain is also included inthe estimate. Lump sum provisions for sea wall strengthening, sub soil investigation, water supply and sanitary arrangement, Electrification and yard lighting are also included in the estimate. Lump sum provision for unforeseen expenses @2.5% are also included in the estimate. Total amount of estimate comes to Rupees 23,60,00000/-(Rupees Twenty Three crore Sixty lakh only) including 18% GST charges but excluding consultancy charges. The estimate is prepared in PRICE based on DSR 2018 and cost index is 35.59%. The provisions adopted in the estimate are adequate for proper completion of work.

DEVELOPMENT OF VYPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION- CONSTRUCTION OF FISH LANDING CENTRE AT VALAPPU BEACH

COST ABSTRACT

1	*APPENDIX - A Supplying geosynthetic tubes*	*Rs.*	*15 48 97 319/-*
2	*APPENDIX B CONSTRUCTION OF AUCTION HALL*	*Rs.*	*31 90 663/-*
3	*Appendix C- construction of Toilet block*	*Rs.*	*24 10 666/-*
4	*Appendix D- construction of Parking Area*	*Rs.*	*78 60 744/-*
5	*Appendix E - Construction of Drain*	*Rs.*	*11 44 187/-*
6	*Seawall Strengthening*	*Rs.*	*2 00 00 000/-*
7	*Sub soil investigation*	*Rs.*	*15 00 000/-*
8	*Water supply and sanitary arrangement*	*Rs.*	*25 00 000/-*
9	*Electrification and yard lighting*	*Rs.*	*15 50 000/-*
10	*Unforeseen expenses @ 2.5%*	*Rs.*	*49 00 000/-*
11	*Sub Total*	*Rs.*	*19 99 53 579/-*
12	*GST @ 18%*	*Rs.*	*3 59 91 644/-*
13	*Total Amount including GST 18%*	*Rs.*	*23 59 45 223/-*
14	*Lumpsum for Round off*	*Rs.*	*54 777/-*
15	*Total Amount*	*Rs.*	*23 60 00 000/-*
16	*Consultancy @5%*	*Rs.*	*1 18 00 000/-*
17	*GST on consultancy @ 18%*	*Rs.*	*21 24 000/-*
18	*Round off*	*Rs.*	*76 000/-*
19	*Grand Total*	*Rs.*	*25 00 00 000/-*

Rupees Twenty Five Crore Only

DEVELOPMENT OF VYPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION- CONSTRUCTION OF FISH LANDING CENTRE AT VALAPPU BEACH

General Abstract

(Dsor year: **2018**,Cost Index Applied for this estimate is **35.59**%)

Sl No	Heading Description	Amount
1	**APPENDIX - A Supplying geosynthetic tubes**	154897318.97
2	**APPENDIX B CONSTRUCTION OF AUCTION HALL**	3190663.46
3	**Appendix C- construction of Toilet block**	2410665.96
4	**Appendix D- construction of Parking Area**	7860743.54
5	**Appendix E - Construction of Drain**	1144187.11
6	**Seawall Strengthening**	20000000.00
7	**Sub soil investigation**	1500000.00
8	**Water supply and sanitary arrangement**	2500000.00
9	**Electrification and yard lighting**	1550000.00
10	**Unforeseen expenses @ 2.5%**	4900000.00
	Provision for GST payments (in %) @	**18.0%**
	Amount reserved for GST payments	**35991644.23**
	Total	**235945223.23**
	Lumpsum for round off	**54776.77**
		TOTAL Rs 236000000.00
		Rounded Total Rs 23,60,00,000
		Rupees Twenty Three Crore Sixty Lakh Only

(Cost Index Applied for this estimate is 35.59%)

DEVELOPMENT OF VYPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION- CONSTRUCTION OF FISH LANDING CENTRE AT VALAPPU BEACH

Detailed Estimate

(Dsor year: **2018**,Cost Index Applied for this estimate is **35.59**%)

Sl No	Description	No	L	B	D	CF	Quantity	Remark
1 APPENDIX - A Supplying geosynthetic tubes								
1	od207804/2023_2024 Supplying and laying Geotextile 120 gram per sqm membrane (best quality) including providing necessary overlaps, all cost, conveyance, labour charges etc complete as per the instruction of departmental officers at site.							
	Geotextile Mattress	2	82.000	25.000			4100.000	
						Total Quantity	4100.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	4100.000 sqm	
						Say 4100.000 sqm @ Rs 83.20 / sqm	**Rs 341120.00**	
2	od208222/2023_2024 Supplying granite quarry run from approved quarry to sorting site by lorry/ tipper, and sorting the stones into 1 kg to 10 kg category stones of approved quality with specific gravity ranging from 2.65 to 2.8 for forming the filter layer of breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and the measurements of categorized stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater including conveyance from sorting platform and dumping stones using tippler (3.5x2.5 sqm size) or any suitable methods installed at site on a moving crane having a capaciaty of not less than 20T and placing the stones at sea bed in uniform layer of design thickness for forming filter layer of breakwater as per the approved drawing and design and inspecting the profile once in a week including hire and operational charges of T & P, tippler, crane and all incidental charges etc. complete as per the direction of departmental officers at site. Eranakulam District							
	Filter layer below Geotube(30cm)	2/3	820.000	21.600	0.300	2.65	9387.360	
						Total Quantity	9387.360 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	9387.360 tonne	
						Say 9387.360 tonne @ Rs 1640.26 / tonne	**Rs 15397711.11**	
3	od207877/2023_2024 Supplying geosynthetic tubes with 9.42m circumference and 20 m length made up of polypropylene woven geosynthetic fabric made of high strength yarns with weight per unit area not less than 1000 gsm, wide width tensile strength (MD/CD) not less than 200, 200KN/m respectively , factory seam strength not less than 160KN/m, uv resistance at 500 hours not less than 90% retained, maximum apparent opening							

	size 0.25mm, transporting of tubes to filling location, positioning of geotubes with concrete anchor blocks, hydraulic filling of geosynthetic tubes using sea sand with the help of sand pump or any other mechanical means as necessary to achieve designed finished height, closing the port mouth suitably as per the standard practice, conveying and placing in the specified location, inspecting the profile with the help of divers including all cost , stitching charges and labour charges, hire and operational charges of machinery etc including all incidental charges etc complete as per the direction of departmental officers at site							
	GeoTextile tubes (820m)	6	41.000				246.000	
						Total Quantity	246.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	246.000 each	
						Say 246.000 each @ Rs 565684.91 / each	**Rs 139158487.86**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
	2 APPENDIX B CONSTRUCTION OF AUCTION HALL							
1	2.8.1 Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil							
	column footing	16	2.100	2.100	1.900		134.064	
	below out side plinth beam	2*7	3.700	0.450	0.600		13.986	
	cross beam	2	5.800	0.450	0.600		3.132	
	rounded	1	3.818				3.818	
						Total Quantity	155.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	155.000 cum	
						Say 155.000 cum @ Rs 296.94 / cum	**Rs 46025.70**	
2	od207799/2023_2024 Supplying and stacking good quality coconut piles							
	For pile 16 x5 Nos =80 Nos	80	6.000				480.000	
						Total Quantity	480.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	480.000 metre	
						Say 480.000 metre @ Rs 107.64 / metre	**Rs 51667.20**	

3	od207801/2023_2024 Coconut Pile- Driving down coconut pile to lines and levels through soft to medium clay soil strata including all hire charges and labour for fixing, staging platform and all other appliances necessary for pile driving down after pointing the bottom end. Details of one post of 6m long 15 numbers per day 6x15=90m.							
	For coconut pile	80	6.000				480.000	
						Total Quantity	480.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	480.000 metre	
						Say 480.000 metre @ Rs 216.92 / metre	**Rs 104121.60**	
4	od207802/2023_2024 Cutting and removing the excess length of wooden piles to lines and levels and removing the cut end of piles and stacking within 150m							
	excess length of pile	16	1.000				16.000	
						Total Quantity	16.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	16.000 metre	
						Say 16.000 metre @ Rs 154.21 / metre	**Rs 2467.36**	
5	2.18.1 Close timbering over areas including strutting, shoring and packing cavities (wherever required) etc. complete (Measurements to be taken of the face area timbered):Depth not exceeding 1.5 m							
	column excavation side	16*4	2.000	1.200			153.600	
	rounded	1	1.400				1.400	
						Total Quantity	155.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	155.000 sqm	
						Say 155.000 sqm @ Rs 136.88 / sqm	**Rs 21216.40**	
6	od207803/2023_2024 Providing and laying filter media with granular crushed aggregates as per specification to a thickness of not less than 600 mm with smaller size towards the soil and bigger size towards the wall and providing over the entire surface behind abutment, wing wall, return wall to the full height, compacted to firm condition complete as per drawing and technical specification Clause 1204.3.8 of MoRD ncluding cost of all materials ,conveyance,labour charges, etc. complete 							
	bottom of column footing	16	1.900	1.900	0.300		17.328	
	rounding	1	0.672				0.672	

						Total Quantity	18.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	18.000 cum	
						Say 18.000 cum @ Rs 1679.73 / cum	**Rs 30235.14**	
7	50.2.3.1 Pumping or Bailing out water and removing slush etc by using pump set including cost of labour, oil hire charges of pumpset, etc complete							
	For earth work 16 column	2	8.000				16.000	
	For coconut pilling	1	8.000				8.000	
	cc for footing & soling	1	8.000				8.000	
	reinforcement work,shuttering@ concrete for footing	4	8.000				32.000	
						Total Quantity	64.000 hour	
						Total Deducted Quantity	0.000 hour	
						Net Total Quantity	64.000 hour	
						Say 64.000 hour @ Rs 284.60 / hour	**Rs 18214.40**	
8	4.1.8 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)							
	column C1 to C16	16	1.700	1.700	0.200		9.248	
	below plinth beam	2*7	3.700	0.450	0.100		2.331	
	cross beam	8	5.600	0.450	0.100		2.016	
	AH floor	7	5.700	3.700	0.150		22.145	
	rounded	1	0.260				0.260	
						Total Quantity	36.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	36.000 cum	
						Say 36.000 cum @ Rs 6814.89 / cum	**Rs 245336.04**	
9	5.1.2 Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level:1:1:5:3 (1 cement 1.5 coarse sand :3 graded stone aggregate 20 mm nominal size							

	column footing C1 to C16	16	1.500	1.500	0.300		10.800	
		16	((1.5*1.5)+(.4*.3))/2		0.300		5.688	
	column up to plinth	16	0.300	0.400	1.000		1.920	
	rounded	1	0.592				0.592	
						Total Quantity	19.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	19.000 cum	
						Say 19.000 cum @ Rs 9085.14 / cum	**Rs 172617.66**	
10	5.2.2 Reinforced cement concrete work in walls (any thickness), including attached pilasters, buttresses, plinth and string courses, fillets, columns, pillars, piers, abutments, posts and struts etc. up tot floor five level excluding cost of centering, shuttering, finishing and reinforcement :1:1.5:3(1 cement : 1.5 coarse sand : 3 graded stone aggregate 20 mm nominal size)							
	plinth beam	2	28.300	0.300	0.300		5.094	
	-do- cross	8	5.800	0.300	0.400		5.569	
	column up to beam C1 to C16	16	0.400	0.300	4.000		7.680	
	roof beam long	2	28.300	0.300	0.350		5.943	
	inglind beam	2*8	3.200	0.300	0.350		5.376	
	roof slab	2	29.500	4.5500	0.120		32.214	
	rounded	1	0.124				0.124	
						Total Quantity	62.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	62.000 cum	
						Say 62.000 cum @ Rs 10954.04 / cum	**Rs 679150.48**	
11	5.9.1 Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete							
	Column base	16*4	1.500	0.300			28.800	
	Column up to plinth	16*2	0.400		1.100		14.081	
		16*2	0.300		1.100		10.560	
	rounded	1	0.559				0.559	
						Total Quantity	54.000 sqm	

						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	54.000 sqm	
						Say 54.000 sqm @ Rs 335.31 / sqm	**Rs 18106.74**	
12	5.9.3 Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform							
	roof slab bottom	2*7	3.700	3.200			165.761	
	side projection	2*2	4.500	0.600			10.800	
	slab projection	2	29.500	1.000			59.000	
	slab projection side	2	29.500	0.120			7.080	
	end side	2*2	4.500	0.120			2.160	
	rounded	1	5.199				5.199	
						Total Quantity	250.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	250.000 sqm	
						Say 250.000 sqm @ Rs 815.78 / sqm	**Rs 203945.00**	
13	5.9.5 Centering and shuttering including strutting, etc. and removal of form for:Lintels, beams, plinth beams, girders bressumers and cantilevers							
	plinth beam out side	2	28.300	0.300			16.980	
	plinth beam in side	2*7	3.700	0.300			15.541	
	cross beam	8*2	5.800	0.400			37.120	
	roof beam out side	2	28.300	0.300			16.980	
	roof beam in side	2*7	3.700	0.400			20.721	
	roof beam bottom	2*7	3.700	0.300			15.541	
	inglind beam side	2*8*2	3.200	0.350			35.840	
	inglind beam bottom	2*8	3.200	0.300			15.360	
	rounded	1	0.917				0.917	
						Total Quantity	175.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	175.000 sqm	
						Say 175.000 sqm @ Rs 649.82 / sqm	**Rs 113718.50**	
14	5.9.6 Centering and shuttering including strutting, etc. and removal of form for:Columns, Pillars, Piers, Abutments, Posts and Struts							

	column C1 to C16	16*2	0.400	4.000			51.200	
		16*2	0.300	4.000			38.400	
	rounded	1	0.400				0.400	
						Total Quantity	90.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	90.000 sqm	
						Say 90.000 sqm @ Rs 863.64 / sqm	**Rs 77727.60**	
15	5.22.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more							
	For column footing	1	16.580			100.0	1658.000	@100kg/ m3
	column up to plinth	1	1.800			120.0	216.000	@120kg/ m3
	rounded	1	6.000				6.000	@120kg/ m3
						Total Quantity	1880.000 kilogram	
						Total Deducted Quantity	0.000 kilogram	
						Net Total Quantity	1880.000 kilogram	
						Say 1880.000 kilogram @ Rs 98.30 / kilogram	**Rs 184804.00**	
16	5.22A.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Thermo - Mechanically Treated bars of grade Fe-500D or more							
	qty vide item No 10 @ 100kg/m3	1	61.876			100.0	6187.600	@100 kg /m3
	rounded	1	12.400				12.400	@100 kg /m3
						Total Quantity	6200.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	6200.000 kg	
						Say 6200.000 kg @ Rs 98.30 / kg	**Rs 609460.00**	
17	7.1.1 Random rubble masonry with hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 (1 cement : 6 coarse sand : 12 graded stone aggregate 20 mm nominal size) up to plinth level with:Cement mortar 1:6 (1 cement : 6 coarse sand)							
	below out side plinth beam	2*7	3.700	0.450	0.600		13.986	

	below cross beam	2	5.800	0.450	0.600		3.132	
	rounded	1	0.882				0.882	
						Total Quantity	18.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	18.000 cum	
						Say 18.000 cum @ Rs 7204.78 / cum	**Rs 129686.04**	
18	2.25 Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.							
	in betwen plinth beams	7	5.700	3.700	0.300		44.290	
	Back filling footing trenches	16	3.000				48.000	
	rounded	1	2.710				2.710	
						Total Quantity	95.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	95.000 cum	
						Say 95.000 cum @ Rs 258.57 / cum	**Rs 24564.15**	
19	13.7.1 12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)							
	For the roof slabs. Top	2	29.500	4.5500			268.450	
	side	2	29.500	0.130			7.670	
	end side	2	9.050	0.130			2.353	
	rounded	1	1.527				1.527	
						Total Quantity	280.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	280.000 sqm	
						Say 280.000 sqm @ Rs 401.21 / sqm	**Rs 112338.80**	
20	13.16.1 6 mm cement plaster of mix:1:3 (1 cement : 3 fine sand)							
	For cross beams side	2*8	6.200	0.350			34.720	
	bottom	8	6.200	0.300			14.880	
	long beam in side	2*7	3.700	0.400			20.721	

	long beam out side	2	28.300	0.300			16.980	
	bottom	2*7	3.700	0.300			15.541	
	slab bottom	2*7	3.700	3.200			165.761	
	roof projection end	2*2	4.500	0.600			10.800	
	out side beam projection side	2	29.500	1.050			61.950	
	column	16	4.000	1.400			89.600	
		1	4.047	1.000			4.047	
						Total Quantity	435.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	435.000 sqm	
						Say 435.000 sqm @ Rs 267.59 / sqm	**Rs 116401.65**	
21	13.4.1 12 mm cement plaster of mix:1:4 (1 cement : 4 coarse sand)							
	Auction hall floor	1	28.300	6.400			181.120	
	Rounded	1	3.880				3.880	
						Total Quantity	185.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	185.000 sqm	
						Say 185.000 sqm @ Rs 325.01 / sqm	**Rs 60126.85**	
22	13.43.1 Applying one coat of water thinnable cement primer of approved brand and manufacture on wall surface:Water thinnable cement primer							
	roof beam side & bottom	8	6.200	1.000			49.600	
	long beam out side	2	28.300	0.400			22.640	
	inside	2*7	3.700	0.400			20.721	
	bottom	2*7	3.700	0.300			15.541	
	slab bottom	2*7	3.700	3.200			165.761	
	roff projection end	2*2	4.500	0.600			10.800	
	roff projection side	2	29.500	1.050			61.950	
	column	16	4.000	1.400			89.600	
	side end	2	9.050	0.130			2.353	
	projection side	2	29.500	0.130			7.670	

	top of roof slab	2	29.500	4.550			268.450	
	rounded	1	4.914				4.914	
						Total Quantity	720.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	720.000 sqm	
						Say 720.000 sqm @ Rs 70.64 / sqm	**Rs 50860.80**	
23	13.44.1 Finishing walls with water proofing cement paint of required shade:New work (Two or more coats applied @ 3.84 kg/10 sqm)							
	slab bottom	2*7	3.700	3.200			165.761	
	roof projection end	2*2	4.500	0.600			10.800	
	roof projection side	2	29.500	1.050			61.950	
		1	1.489				1.489	
						Total Quantity	240.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	240.000 sqm	
						Say 240.000 sqm @ Rs 107.39 / sqm	**Rs 25773.60**	
24	13.46.1 Finishing walls with Acrylic Smooth exterior paint of required shade:New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm)							
	roof beam allround	8	6.200	1.000			49.600	
	long beam out side	2	28.300	0.300			16.980	
	long beam in side	2*7	3.700	0.400			20.721	
	bottom	2*7	3.700	0.300			15.541	
	column C1 to C16	16	4.000	1.400			89.600	
	top of roof slab	2	29.500	4.550			268.450	
	side	2	29.500	0.130			7.670	
	side end	2	9.050	0.130			2.353	
		1	4.085				4.085	
						Total Quantity	475.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	475.000 sqm	
						Say 475.000 sqm @ Rs 193.89 / sqm	**Rs 92097.75**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark

3 Appendix C- construction of Toilet block								
1	2.8.1 Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil							
	toilet block foundation all round	1	35.500	0.800	0.750		21.300	
	crosswall long	2	11.500	0.800	0.750		13.800	
	cross	1	6.050	0.800	0.750		3.630	
		1	3.150	0.800	0.750		1.891	
	bath room	1	4.800	0.800	0.750		2.880	
	ramp	2	4.500	0.800	0.750		5.400	
	step	1	3.500	1.200	0.600		2.520	
		1	3.000	0.800	0.750		1.801	
	setitank	1	6.700	2.400	2.000		32.160	
	sock pit	1	1.800	1.800	1.500		4.860	
		1	4.758				4.758	
						Total Quantity	95.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	95.000 cum	
						Say 95.000 cum @ Rs 296.94 / cum	**Rs 28209.30**	
2	2.26.1 Extra for every additional lift 1.5 m or part there of in excavation / banking excavated or stacked materials.All kinds of soil							
	tank	1	6.700	2.400	0.500		8.040	
	rounded	1	1.960				1.960	
						Total Quantity	10.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	10.000 cum	
						Say 10.000 cum @ Rs 106.37 / cum	**Rs 1063.70**	
3	4.1.8 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)							

	toilet block foundation all round	1	35.500	0.800	0.150		4.260	
	crosswall long	2	11.500	0.800	0.150		2.761	
	cross	1	6.050	0.800	0.150		0.726	
		1	3.150	0.800	0.150		0.378	
	bath room	1	4.800	0.800	0.150		0.576	
	ramp	2	4.500	0.800	0.150		1.080	
	step	1	3.500	1.200	0.150		0.630	
		1	3.000	0.800	0.150		0.361	
	setitank	1	6.700	2.400	0.200		3.216	
	floor room	1	12.150	4.800	0.100		5.833	
	ramp& varandha	1	13.500	1.200	0.100		1.620	
	rounded	1	0.559				0.559	
						Total Quantity	22.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	22.000 cum	
						Say 22.000 cum @ Rs 6814.89 / cum	**Rs 149927.58**	
4	7.1.1 Random rubble masonry with hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 (1 cement : 6 coarse sand : 12 graded stone aggregate 20 mm nominal size) up to plinth level with:Cement mortar 1:6 (1 cement : 6 coarse sand)							
	toilet block foundation all round	1	35.500	0.600	0.600		12.780	
	crosswall long	2	11.500	0.600	0.600		8.280	
	cross	1	6.050	0.600	0.600		2.178	
		1	3.150	0.600	0.600		1.134	
	bath room	1	4.800	0.600	0.600		1.728	
	ramp	2	4.500	0.600	0.600		3.240	
	step	1	3.500	1.200	0.450		1.891	
		1	3.000	0.600	0.600		1.080	
	toilet block basement all round	1	35.500	0.450	0.450		7.189	
	crosswall long	2	11.500	0.450	0.450		4.658	
	cross	1	6.050	0.450	0.450		1.226	
		1	3.150	0.450	0.450		0.638	

	bath room	1	4.800	0.450	0.450		0.973	
	ramp	2	3.150	0.450	0.300		0.851	
		1	3.000	0.450	0.450		0.608	
	partition	10	1.500	0.450	0.450		3.038	
	rounded	1	0.508				0.508	
						Total Quantity	52.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	52.000 cum	
						Say 52.000 cum @ Rs 7204.78 / cum	**Rs 374648.56**	
5	2.25 Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.							
	for foundation	1	11.550	3.900	0.600		27.027	
	varandha	1	7.000	0.750	0.600		3.150	
	rounded	1	4.823				4.823	
						Total Quantity	35.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	35.000 cum	
						Say 35.000 cum @ Rs 258.57 / cum	**Rs 9049.95**	
6	5.2.2 Reinforced cement concrete work in walls (any thickness), including attached pilasters, buttresses, plinth and string courses, fillets, columns, pillars, piers, abutments, posts and struts etc. up tot floor five level excluding cost of centering, shuttering, finishing and reinforcement :1:1.5:3(1 cement : 1.5 coarse sand : 3 graded stone aggregate 20 mm nominal size)							
	basement allround	1	35.500	0.450	0.100		1.598	
	cross	1	11.500	0.450	0.100		0.518	
		1	6.050	0.450	0.100		0.273	
		1	3.150	0.450	0.100		0.142	
	bath	1	4.800	0.450	0.100		0.217	
	ramp	1	3.150	0.450	0.100		0.142	
		1	3.000	0.450	0.100		0.135	
	partition	10	1.500	0.450	0.100		0.675	
	lintel	1	76.000	0.150	0.150		1.710	
	roof slab	1	12.750	5.800	0.120		8.874	

	slop	1	39.450	1.000	0.120		4.734	
	tank bottom	1	6.000	2.100	0.150		1.891	
	beam	1	2.100	0.200	0.200		0.085	
	cover slab	1	6.000	2.100	0.120		1.512	
		1	1.800	1.800	0.120		0.389	
	rounded	1	0.105				0.105	
						Total Quantity	23.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	23.000 cum	
						Say 23.000 cum @ Rs 10954.04 / cum	**Rs 251942.92**	
7	5.9.3 Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform							
	basement top	2	35.500	0.100			7.101	
	cross	2	11.500	0.100			2.301	
		2	6.050	0.100			1.210	
		2	3.150	0.100			0.630	
	bath	2	4.800	0.100			0.960	
	ramp	2	6.150	0.100			1.231	
	partition	10*2	1.500	0.100			3.001	
	lintel	2	76.000	0.150			22.800	
	roof slab	1	12.750	5.800			73.950	
	slop	1	39.450	1.000			39.450	
	tank bottom	4	10.200	0.150			6.120	
	beam	1	2.100	0.600			1.260	
	cover slab	12	5.100	0.120			7.344	
		3	4.800	0.120			1.728	
		1	0.914				0.914	
						Total Quantity	170.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	170.000 sqm	
						Say 170.000 sqm @ Rs 815.78 / sqm	**Rs 138682.60**	
8	5.22A.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and							

	binding all complete above plinth level.Thermo - Mechanically Treated bars of grade Fe-500D or more							
	qty of cc	1	22.895			100.0	2289.500	@100kg/ m3
	rounded	1	10.500				10.500	@100kg/ m3
						Total Quantity	2300.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	2300.000 kg	
						Say 2300.000 kg @ Rs 98.30 / kg	**Rs 226090.00**	
9	50.6.2.2 Solid masonry using pre cast solid blocks (factory made) of size 30x20x15cm or nearest available size confirming to IS 2185 part I of 1979 for super structure up to floor two level with thickness 15cm in : CM 1:6 (1 cement : 6 coarse sand) etc complete							
	wall all round	1	34.500	2.800	0.150		14.490	
	cross wal	1	12.150	2.800	0.150		5.103	
	centre cross	1	3.150	2.800	0.150		1.323	
		1	6.050	2.800	0.150		2.541	
	bath	1	4.800	2.800	0.150		2.016	
	septitank	1	16.200	1.800	0.200		5.833	
	step	1	3.000	0.600	0.450		0.810	
	rounded	1	0.593				0.593	
	shutter	1	3.000	2.400	0.150		-1.079	
	door D DA toilet	2	1.000	2.100	0.150		-0.630	
						Total Quantity	32.709 cum	
						Total Deducted Quantity	-1.709 cum	
						Net Total Quantity	31.000 cum	
						Say 31.000 cum @ Rs 6984.85 / cum	**Rs 216530.35**	
10	50.6.3.2 Solid block masonry using pre cast solid blocks (Factory made) of size 40x20x10 cm or nearest available size confirming to IS 2185 part I of 1979 for super structure up to floor two level for 10 cm thick wall in : CM 1:6 (1 cement : 6 coarse sand) including cost of scaffolding complete							
	toilet partition	10	1.500	2.800	0.100		4.200	
	urinal partition	2	1.000	1.400	0.100		0.280	
	parapet	1	37.100	0.600	0.100		2.227	
	seititank partition	2	1.700	1.000	0.100		0.340	

	sock pit	4	1.700	1.200	0.100		0.817	
	rounded	1	0.459				0.459	
	door D1	9	0.700	2.100	0.100		-1.323	
						Total Quantity	8.323 cum	
						Total Deducted Quantity	-1.323 cum	
						Net Total Quantity	7.000 cum	
						Say 7.000 cum @ Rs 7823.61 / cum	**Rs 54765.27**	
11	13.1.1 12 mm cement plaster of mix:1:4 (1 cement : 4 fine sand)							
	out side wall	1	35.300	2.800			98.840	
	Parapet	1	37.100	1.400			51.940	
	toilet inside	10	5.400	2.800			151.200	
	DA toilet	2	6.600	2.800			36.960	
	out side	2	4.800	2.800			26.880	
	bath	1	6.500	2.800			18.200	
	partition	2	3.150	2.800			17.640	
		1	5.300	2.800			14.840	
		1	5.500	2.800			15.400	
		1	3.200	2.800			8.960	
		1	4.850	2.800			13.580	
		1	2.500	2.800			7.000	
	urinal partition	2	2.100	1.500			6.301	
	under side slab	1	12.750	5.800			73.950	
		1	39.450	1.000			39.450	
	rounded	1	5.927				5.927	
	door D	2	1.000	2.100			-4.200	
	toilet door D1	11	0.700	2.100			-16.169	
	ventilator	15	0.600	0.500			-4.500	
	shutter	1	3.000	2.400			-7.199	
						Total Quantity	587.068 sqm	
						Total Deducted Quantity	-32.068 sqm	
						Net Total Quantity	555.000 sqm	
						Say 555.000 sqm @ Rs 314.09 / sqm	**Rs 174319.95**	

12	13.7.1 12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)							
	slab top	1	12.750	5.800			73.950	
		1	39.450	1.000			39.450	
	rounded	1	1.600				1.600	
						Total Quantity	115.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	115.000 sqm	
						Say 115.000 sqm @ Rs 401.21 / sqm	**Rs 46139.15**	
13	13.7.2 12 mm cement plaster finished with a floating coat of neat cement of mix:1:4 (1 cement : 4 fine sand)							
	Septi tank inside	1	15.400	1.800			27.721	
	bottom	1	6.000	1.700			10.200	
	partition wall	2*2	1.700	1.000			6.800	
	roumnded	1	0.279				0.279	
						Total Quantity	45.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	45.000 sqm	
						Say 45.000 sqm @ Rs 386.36 / sqm	**Rs 17386.20**	
14	8.31 Providing and fixing Ist quality ceramic glazed wall tiles conforming to IS: 15622(thickness to be specified by the manufacturer), of approved make, in all colours,shades except burgundy, bottle green, black of any size as approved by Engineerin-Charge,in skirting, risers of steps and dados, over 12 mm thick bed of cementmortar 1:3 (1 cement : 3 coarse sand) and jointing with grey cement slurry @3.3kg per sqm, including pointing in white cement mixed with pigment of matchingshade complete.							
	toilet	11	4.700	1.800			93.060	
	DA toilet	2	5.600	1.800			20.160	
	bath	1	5.800	1.800			10.440	
	urinal portion	3	2.600	1.600			12.480	
	rounded	1	3.860				3.860	
						Total Quantity	140.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	140.000 sqm	
						Say 140.000 sqm @ Rs 1212.78 / sqm	**Rs 169789.20**	
15	11.37							

	Providing and laying Ceramic glazed floor tiles of size 300x300 mm (thickness to be specified by the manufacturer), of 1st quality conforming to IS : 15622, of approved make, in colours such as White, Ivory, Grey, Fume Red Brown, laid on 20 mm thick cement mortar 1:4 (1 Cement : 4 Coarse sand), including pointing the joints with white cement and matching pigment etc., complete.							
	inside floor	1	12.150	4.800			58.320	
	Rounded	1	1.680				1.680	
						Total Quantity	60.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	60.000 sqm	
						Say 60.000 sqm @ Rs 1091.02 / sqm	**Rs 65461.20**	
16	od207809/2023_2024 :Providing and laying industrial grade antiskid tiles of size 300x300mm with thickness 9mm or nearest with water absorption less than 0.08 % and conforming to I.S. 15622, of approved make, in all colours & shades,laid on 20 mm thick cement mortar 1:4 (1 cement : 4 coarse sand), including grouting the joint with white cement & matching pigments etc. complete.							
	ramp	2	5.200	1.200			12.480	
		1	3.500	1.200			4.200	
	step	3	3.000	0.450			4.051	
	Rounded	1	2.269				2.269	
						Total Quantity	23.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	23.000 sqm	
						Say 23.000 sqm @ Rs 1276.95 / sqm	**Rs 29369.85**	
17	13.43.1 Applying one coat of water thinnable cement primer of approved brand and manufacture on wall surface:Water thinnable cement primer							
	area vide item no 11	1	555.000				555.000	
						Total Quantity	555.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	555.000 sqm	
						Say 555.000 sqm @ Rs 70.64 / sqm	**Rs 39205.20**	
18	13.46.1 Finishing walls with Acrylic Smooth exterior paint of required shade:New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm)							
	out side wall	1	35.300	2.800			98.840	
	Parapet	1	37.100	1.400			51.940	

	rounded	1	4.220				4.220	
						Total Quantity	155.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	155.000 sqm	
						Say 155.000 sqm @ Rs 193.89 / sqm	**Rs 30052.95**	
19	13.83.2 Wall painting with premium acrylic emulsion paint of interior grade, having VOC (Volatile including applying additional coats wherever required to achieve even shade and colour.Two coats							
	toilet inside	10	5.400	1.000			54.000	
	DA toilet	2	6.600	1.000			13.200	
	out	2	4.800	2.800			26.880	
	bath	1	6.500	1.000			6.500	
	partition	2	3.150	2.800			17.640	
		1	5.300	2.800			14.840	
		1	5.500	2.800			15.400	
		1	3.200	2.800			8.960	
		1	4.850	2.800			13.580	
		1	2.500	2.800			7.000	
	urinal partition	2	2.100	1.500			6.301	
	under side slab	1	12.750	5.800			73.950	
		1	39.450	1.000			39.450	
	rounded	1	4.367				4.367	
	door D	2	1.000	2.100			-4.200	
	toilet door	11	0.700	2.100			-16.169	
	ventilator	15	0.600	0.500			-4.500	
	shutter	1	3.000	2.400			-7.199	
						Total Quantity	302.068 sqm	
						Total Deducted Quantity	-32.068 sqm	
						Net Total Quantity	270.000 sqm	
						Say 270.000 sqm @ Rs 134.10 / sqm	**Rs 36207.00**	
20	9.117.1 Providing and fixing factory made uPVC door frame made of uPVC extruded sections having an overall dimension as below (tolerance ±1 mm), with wall thickness 2.0mm (±0.2 mm), corners of the door frame to be jointed with galvanized brackets and stainless steel screws, joints mitred and plastic welded. The hinge side vertical of the frames reinforced by galvanized M.S. tube of size 19 x 19 mm and 1 mm (± 0.1							

	mm) wall thickness and 3 nos. stainless steel hinges fixed to the frame complete as per manufacturer's specification and direction of Engineer-in-chargeExtruded section profile size 48x40 mm							
	Toilet door 70x210	11	5.600				61.600	
	DA toilet,100x210	2	6.200				12.400	
	rounded	1	1.000				1.000	
						Total Quantity	75.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	75.000 metre	
						Say 75.000 metre @ Rs 260.94 / metre	**Rs 19570.50**	
21	9.118.1 Providing and fixing to existing door frames24 mm thick factory made PVC door shutters made of styles and rails of a uPVC hollow section of size 59x24 mm and wall thickness 2 mm (± 0.2 mm) with inbuilt edging on both sides. The styles and rails mitred and joint at the corners by means of M.S. galvanised/plastic brackets of size 75x220 mm having wall thickness 1.0 mm and stainless steel screws. The styles of the shutter reinforced by inserting galvanised M.S. tube of size 20x20 mm and 1 mm (± 0.1 mm) wall thickness. The lock rail made up of 'H' section, a uPVC hollow section of size 100x24 mm and 2 mm (± 0.2 mm) wall thickness,fixed to the shutter styles by means of plastic/galvanised M.S. 'U' cleats. The shutter frame filled with a uPVC multi-chambered single panel of size not less than 620 mm, having over all thickness of 20 mm and 1 mm (± 0.1 mm) wall thickness. The panels filled vertically and tie bar at two places by inserting horizontally 6 mm galvanised M.S. rod and fastened with nuts and washers, complete as per manufacturer's specification and direction of Engineer-in-charge(For W.C. and bathroom door shutter).							
	Toilet door 70x210	11	0.700	2.100			16.170	
	DA toilet,100x210	2	1.000	2.100			4.200	
	rounded	1	0.630				0.630	
						Total Quantity	21.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	21.000 sqm	
						Say 21.000 sqm @ Rs 2072.49 / sqm	**Rs 43522.29**	
22	9.147B.1 543SUB HEAD : 9 - WOOD & PVC WORK9.147BProviding and fixing factory made uPVC white colour fixed glazed windows/ventilators comprising of uPVC multi-chambered frame and mullion (where everrequired) extruded profiles duly reinforced with 1.60 ± 0.2 mm thick galvanizedmild steel section made from roll forming process of required length (shape &size according to uPVC profile), , uPVC extruded glazing beads of appropriatedimension, EPDM gasket, G.I fasteners 100 x 8 mm size for fixing frame to finishedwall, plastic packers, plastic caps and necessary stainless steel screws etc.Profile of frame shall be mitred cut and fusion welded at all corners, mullion (ifrequired) shall be also fusion welded including drilling of holes for fixinghardware's and drainage of water etc. After fixing frame the gap between frameand adjacent finished wall shall be filled with weather proof silicon sealant overbacker rod of required size and of approved quality, all complete as per approveddrawing & direction of Engineer-in-							

	Charge. (Single / double glass panes andsilicon sealant shall be paid separately). Note: For uPVC frame, sash and mullion extruded profiles minus 5% tolerancein dimension i.e. in depth & width of profile shall be acceptable.Fixed window / ventilator made of (small series) frame 47 x 50 mm & mullion 47x 68 mm both having wall thickness of 1.9 ± 0.2 mm and single glazing bead ofappropriate dimension. (Area upto 0.75 sqm.)							
	for ventilator	15	0.600	0.500			4.500	
						Total Quantity	4.500 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	4.500 sqm	
						Say 4.500 sqm @ Rs 7626.06 / sqm	**Rs 34317.27**	
23	10.3 Providing and fixing in position collapsible steel shutters with vertical channels 20x10x2 mm and braced with flat iron diagonals 20x5 mm size, with top and bottom rail of T-iron 40x40x6 mm, with 40 mm dia steel pulleys, complete with bolts, nuts,locking arrangement, stoppers, handles, including applying a priming coat of approved steel primer .							
	Front shutter	1	3.500	2.400			8.400	
	Rounded	1	0.600				0.600	
						Total Quantity	9.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	9.000 sqm	
						Say 9.000 sqm @ Rs 10205.93 / sqm	**Rs 91853.37**	
24	10.28 Providing and fixing stainless steel (Grade 304) railing made of Hollow tubes, channels, plates etc., including welding, grinding, buffing, polishing and making curvature (wherever required) and fitting the same with necessary stainless steel nuts and bolts complete, i/c fixing the railing with necessary accessories & stainless steel dash fasteners, stainless steel bolts etc., of required size on the top of the floor or the side of waist slab with suitable arrangement as per approval of Engineer-in-charge, (for payment purpose only weight of stainless steel members shall be considered excluding fixing accessories such as nuts, bolts, fasteners etc.)							
	hand rail	2	6.000			20.0	240.000	@20kg/m
						Total Quantity	240.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	240.000 kg	
						Say 240.000 kg @ Rs 677.34 / kg	**Rs 162561.60**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
4 Appendix D- construction of Parking Area								

1	16.78.1 Construction of granular sub- base by Providing close graded Material conforming to specifications, mixing in a mechanical mix plant at OMC, Carriage of mixed material by tippers to work site, for all leads & lifts, spreading in uniform layers of specified thickness with motor grader on prepared surface and compacting with vibratory power roller to achieve the desired density, complete as per specifications and directions of Engineer-in- Charge.With Material conforming to Grade - I (size range 75 mm to 0.075 mm) having CBR Value- 30							
	Auction hall front	1	40.000	30.000	0.150		180.000	
	side	2	6.000	6.000	0.150		10.800	
	AH west side	1	40.000	15.000	0.150		90.000	
	for road	1	30.000	6.000	0.150		27.000	
	rounded	1	4.200				4.200	
						Total Quantity	312.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	312.000 cum	
						Say 312.000 cum @ Rs 2963.59 / cum	**Rs 924640.08**	
2	16.80 Construction of dry lean cement concrete sub base over a prepared sub - grade with coarse and fine aggregate conforming to IS : 383, the size of coarse aggregate not exceeding 25 mm, aggregate cement ration not to exceed 15:1, aggregate gradation after blending to be as per specification, cement content not to be less than 150 Kg/ cum, optimum moisture content to be determined during trial length construction, concrete strength not to be less than 10 Mpa at 7 days, mixed in a batching plant, transported to site, for all leads & lifts, laid with a mechanical paver, compacting with 8-10 tonne vibratory roller, finishing and curing etc. complete as per direction of Engineer-in-charge							
	Auction hall front	1	40.000	30.000	0.150		180.000	
	side	2	6.000	6.000	0.150		10.800	
	AH west side	1	40.000	15.000	0.150		90.000	
	for road	1	30.000	6.000	0.150		27.000	
	rounded	1	4.200				4.200	
						Total Quantity	312.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	312.000 cum	
						Say 312.000 cum @ Rs 4569.25 / cum	**Rs 1425606.00**	
3	16.43.1 Providing and laying design mix cement concrete of M-30 grade, in roads/ taxi tracks/ runways, using cement content as per design mix, using coarse sand and graded stone aggregate of 40 mm nominal size in appropriate proportions as per approved & specified design criteria, providing dowel bars with sleeve/tie bars wherever required, laying at site, spreading and compacting mechanically by using needle							

	and surface vibrators, levelling to required slope/ camber, finishing with required texture, including steel form work with sturdy M.S. channel sections, curing, making provision for contraction / expansion, construction & longitudinal joints (10 mm wide x 50 mm deep) by groove cutting machine, providing and filling joints with approved joint filler and sealants, complete all as per direction of Engineer-in-charge (Item of joint fillers, sealants, dowel bars with sleeve/tie bars to be paid separately). Note: Cement content considered in M-30 is @340 kg/cum. Excess/less cement used as per design mix is payable/ recoverable separately.Cement concrete prepared with batch mixing machine							
	Auction hall front	1	40.000	30.000	0.150		180.000	
	side	2	6.000	6.000	0.150		10.800	
	AH west side	1	40.000	15.000	0.150		90.000	
	for road	1	30.000	6.000	0.150		27.000	
	rounded	1	4.200				4.200	
						Total Quantity	312.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	312.000 cum	
						Say 312.000 cum @ Rs 10302.33 / cum	**Rs 3214326.96**	
4	5.22A.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Thermo - Mechanically Treated bars of grade Fe-500D or more							
	qty of CC	1	307.800			75.0	23085.000	@75Kg/m3
	rounded	1	15.000				15.000	@75Kg/m3
						Total Quantity	23100.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	23100.000 kg	
						Say 23100.000 kg @ Rs 98.30 / kg	**Rs 2270730.00**	
5	16.44 Extra for providing and mixing hardening compound of approved quality as per manufacturer's specification in cement concrete.							
	qty of cc 307.8*340=104652(2093 bags	1	2093.000			0.2	418.600	@.20 Kg/bag
	Rounded	1	6.400				6.400	@.20 Kg/bag
						Total Quantity	425.000 Litre	
						Total Deducted Quantity	0.000 Litre	

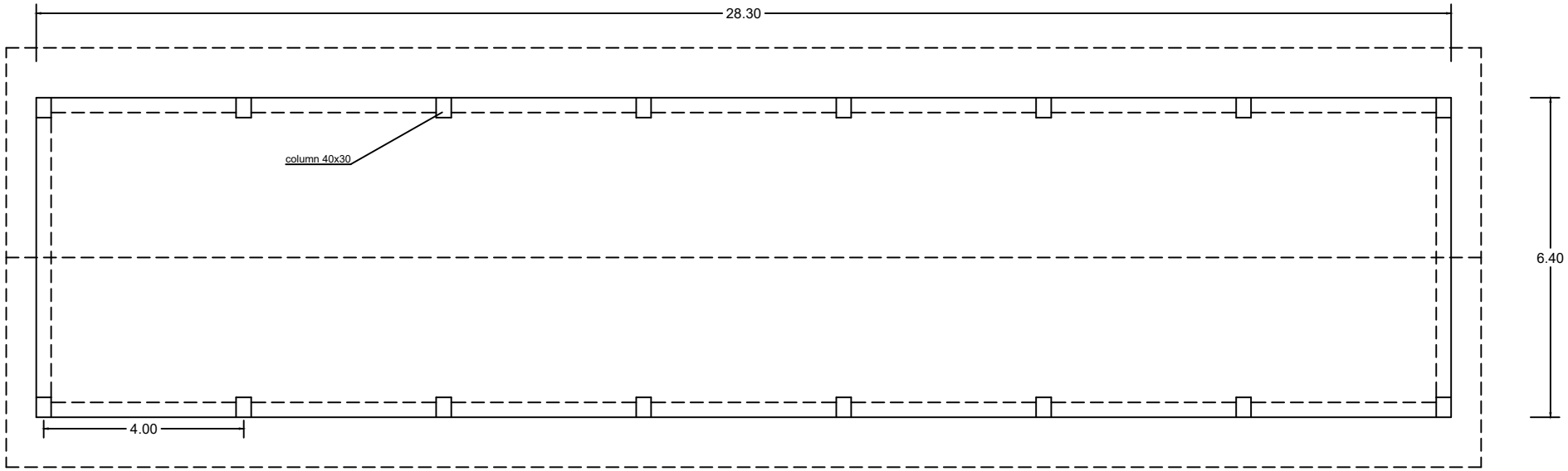
						Net Total Quantity	425.000 Litre	
						Say 425.000 Litre @ Rs 59.86 / Litre	**Rs 25440.50**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
5 Appendix E - Construction of Drain								
1	2.8.1 Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil							
	main drain from Auction hall to sump	1	50.000	1.300	1.000		65.000	
						Total Quantity	65.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	65.000 cum	
						Say 65.000 cum @ Rs 296.94 / cum	**Rs 19301.10**	
2	2.6.1 Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil							
	Pit of sump	1	8.200	4.000	2.450		80.360	
	soak pit 2m dia	1	3.140	1*1	2.100		6.594	
	round of	1	3.046				3.046	
						Total Quantity	90.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	90.000 cum	
						Say 90.000 cum @ Rs 214.03 / cum	**Rs 19262.70**	
3	4.1.8 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)							
	for drain	1	50.000	1.300	0.150		9.750	
	sump bottom	1	8.200	4.000	0.200		6.560	
	round of	1	0.690				0.690	
						Total Quantity	17.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	17.000 cum	

						Say 17.000 cum @ Rs 6814.89 / cum	**Rs 115853.13**	
4	5.1.2 Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level:1:1:5:3 (1 cement 1.5 coarse sand :3 graded stone aggregate 20 mm nominal size							
	drain bottom slab	1	50.000	1.200	0.100		6.000	
	side wall	2	50.000	1.000	0.200		20.000	
	cover slad for drain 50/.5	100	1.000	0.500	0.150		7.500	
	cover slab sump	16	3.500	0.500	0.120		3.360	
	do beam	1	7.500	0.300	0.300		0.675	
	cover slab soak pit	1	3.140	1.100	0.120		0.415	
	round	1	0.050				0.050	
						Total Quantity	38.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	38.000 cum	
						Say 38.000 cum @ Rs 9085.14 / cum	**Rs 345235.32**	
5	5.9.1 Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete							
	side wall drain out	2	50.000	1.000			100.000	
	side wall drain in	2	50.000	0.900			90.000	
						Total Quantity	190.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	190.000 sqm	
						Say 190.000 sqm @ Rs 335.31 / sqm	**Rs 63708.90**	
6	5.9.5 Centering and shuttering including strutting, etc. and removal of form for:Lintels, beams, plinth beams, girders bressumers and cantilevers							
	For cover slab drain 105 x 50 x 15 cm	100	3.100	0.150			46.500	
	For cover slab Effluent tank sides	16	8.000	0.120			15.360	
	beam	1	7.500	0.900			6.750	
	Rounded	1	1.390				1.390	
						Total Quantity	70.000 sqm	

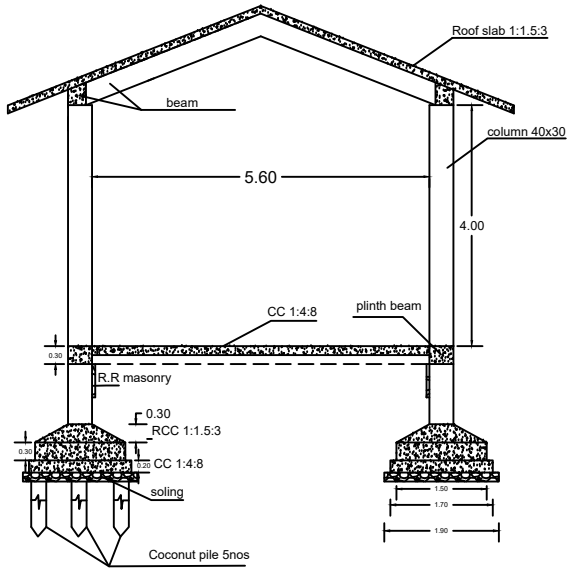
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	70.000 sqm	
						Say 70.000 sqm @ Rs 649.82 / sqm	**Rs 45487.40**	
7	5.22A.1 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Mild steel and Medium Tensile steel bars							
	Qty of CC 38	1	38.000			90.0	3420.000	
						Total Quantity	3420.000 kilogram	
						Total Deducted Quantity	0.000 kilogram	
						Net Total Quantity	3420.000 kilogram	
						Say 3420.000 kilogram @ Rs 96.68 / kilogram	**Rs 330645.60**	
8	50.6.1.1 Solid block masonry using pre cast solid blocks (factory made) of size 40x20x20cm or nearest available size confirming to IS 2185 part 1 of 1979 for foundation and plinth with thickness 20 cm and above in: CM 1:6 (1 cement : 6 coarse sand) etc complete							
	tank side wall	1	21.900	0.200	2.500		10.950	
	soak pit 2.00m dia - bottom	1	6.280	0.200	0.300		0.377	
	Rounded	1	0.673				0.673	
						Total Quantity	12.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	12.000 cum	
						Say 12.000 cum @ Rs 5908.32 / cum	**Rs 70899.84**	
9	6.23 Honey-comb brick work 10/11.4 cm thick with common burnt clay bricks of class designation 7.5 in super structure above plinth level upto floor V level with cement mortar 1:4 (1 cement : 4 coarse sand).							
	soak pit 2.00m dia - bottom	1	6.280	1.300			8.165	
	Rounded	1	0.835				0.835	
						Total Quantity	9.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	9.000 sqm	
						Say 9.000 sqm @ Rs 699.37 / sqm	**Rs 6294.33**	
10	13.7.2 12 mm cement plaster finished with a floating coat of neat cement of mix:1:4 (1 cement : 4 fine sand)							

	for Drain side wall - inside	1	50.000	2.600			130.000	
	Effluent tank side wall	2	31.600	2.500			158.000	
	cross wall	2	3.200	2.500			16.000	
	bottom	1	7.600	3.200			24.320	
	Rounded	1	1.680				1.680	
						Total Quantity	330.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	330.000 sqm	
						Say 330.000 sqm @ Rs 386.36 / sqm	**Rs 127498.80**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
6 Seawall Strengthening								
Lump-Sum Total							**Rs 20000000.00**	
	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**7 Sub soil investigation**							
Lump-Sum Total							**Rs 1500000.00**	
	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**8 Water supply and sanitary arrangement**							
Lump-Sum Total							**Rs 2500000.00**	
	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**9 Electrification and yard lighting**							
Lump-Sum Total							**Rs 1550000.00**	
	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**10 Unforeseen expenses @ 2.5%**							
Lump-Sum Total							**Rs 4900000.00**	
						Provision for GST payments (in %) @	**18.0%**	
						Amount reserved for GST payments	**35991644.23**	
						Total	**235945223.23**	
						Lumpsum for round off	**54776.77**	
							TOTAL Rs 236000000.00	
							Rounded Total Rs 23,60,00,000	
							Rupees Twenty Three Crore Sixty Lakh Only	

(Cost Index Applied for this estimate is 35.59%)

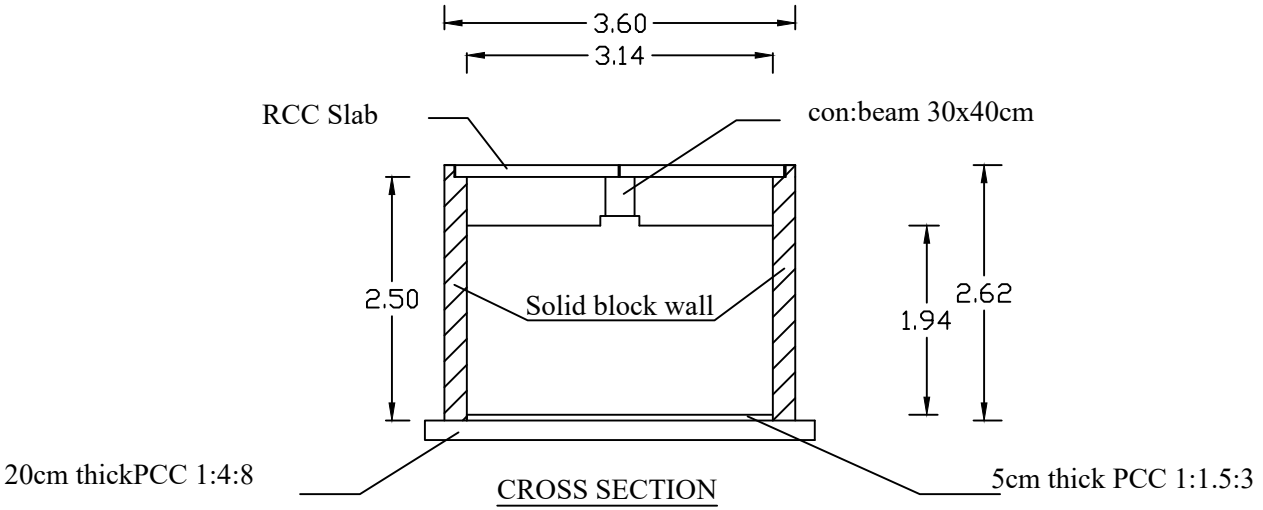


FLC Auction hall plan

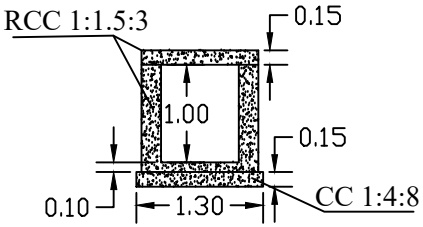


FLC Auction hall cross section

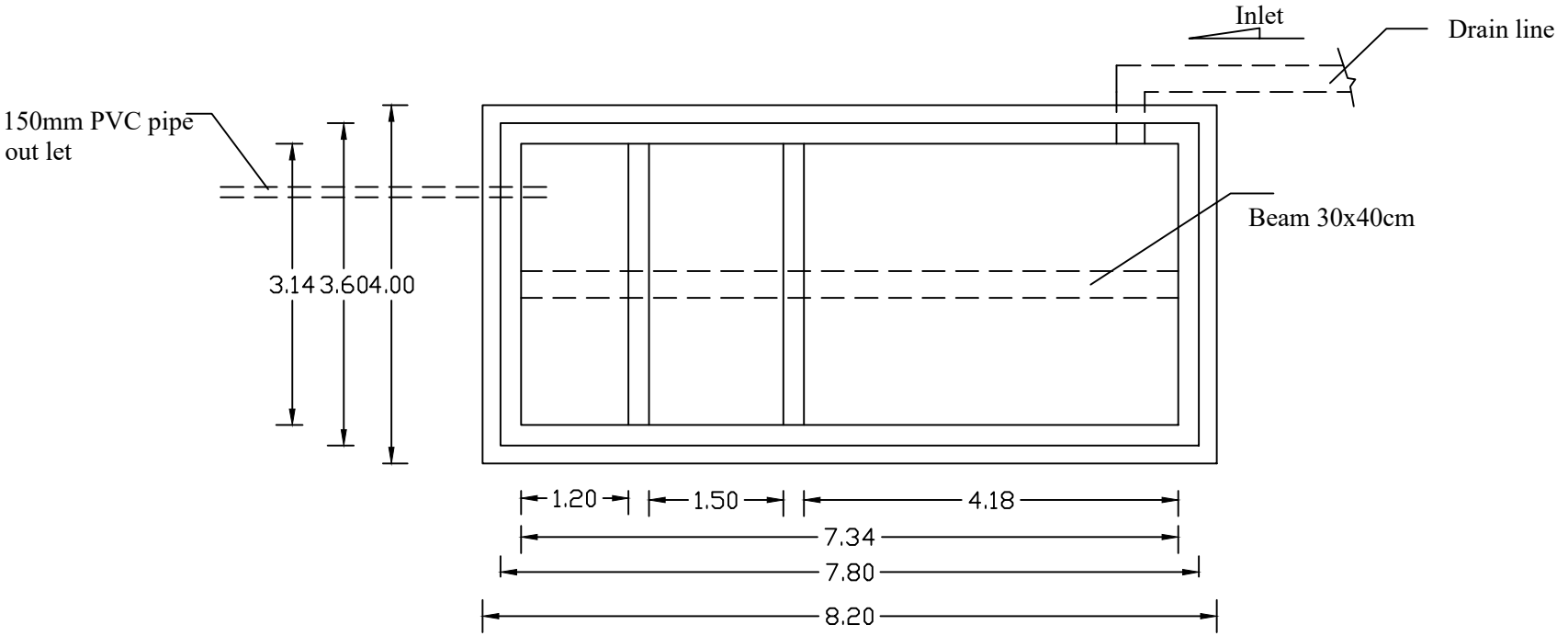
KSCADC	**KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION**	**DEVELOPMENT OF VIPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT VALAPPU BEACH**			
	DRAWING NO:		ASSISTANT ENGINEER:	**ASSISTANT ENGINEER:** SIGNATURE:	**ASSISTANT EXECUTIVE ENGINEER:** SIGNATURE:
	DATE:		DRAWN:		
	TYPE:	**DRAWING**	**REVISION**	**STRUCTURAL CONSULTANT:** DESIGNED & CHECKED BY	**CHIEF ENGINEER:** SIGNATURE:
	TITLE:	FLC AUCTION HALL PLAN & SECTION	1. 2.		



CROSS SECTION

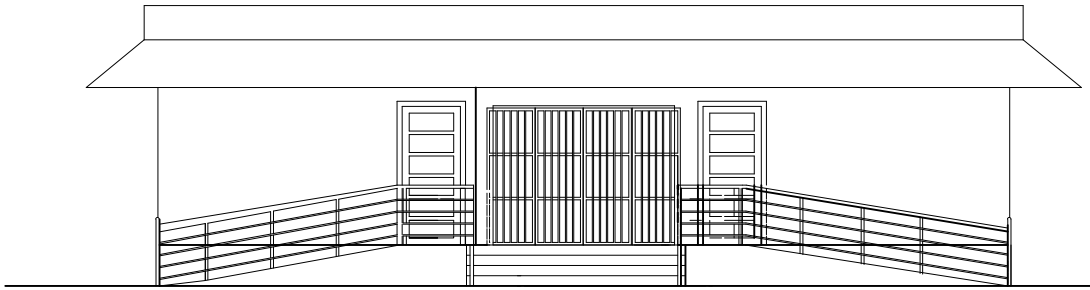


Drain Cross section

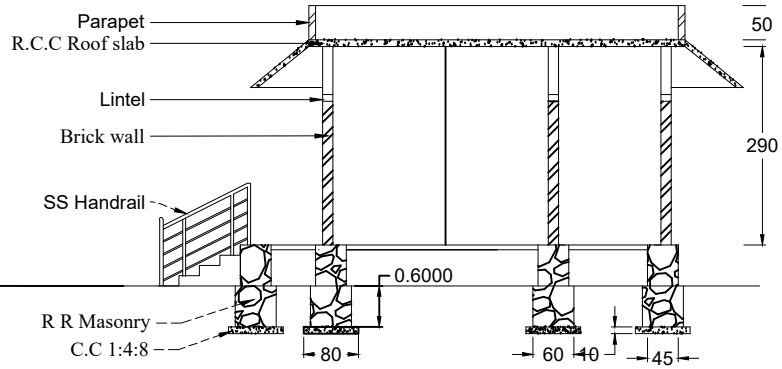


PLAN

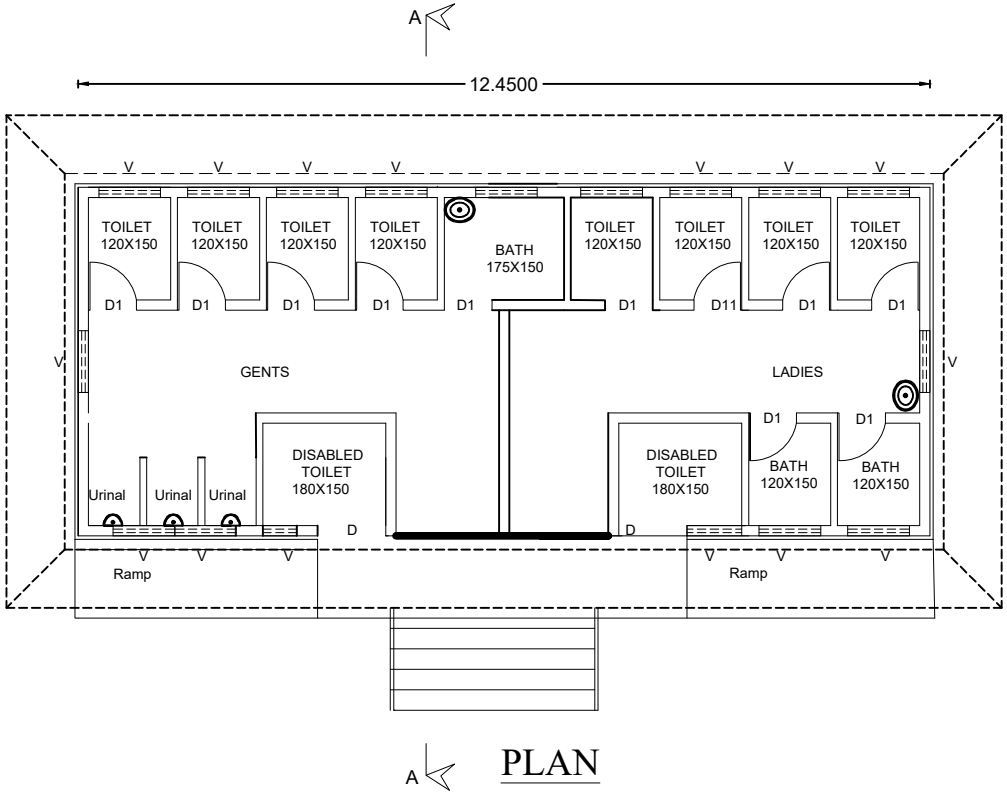
KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION	DEVELOPMENT OF VIPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT VALAPPU BEACH				
	DRAWING NO:		ASSISTANT ENGINEER:	**ASSISTANT ENGINEER:** SIGNATURE:	**ASSISTANT EXECUTIVE ENGINEER:** SIGNATURE:
	DATE:		DRAWN:		
	TYPE:	**DRAWING**	**REVISION**	**STRUCTURAL CONSULTANT:** DESIGNED & CHECKED BY	**CHIEF ENGINEER:** SIGNATURE:
	TITLE:	FISH LANDING CENTRE DRAIN AND TREATMENT TANK	1. 2.		



ELEVATION

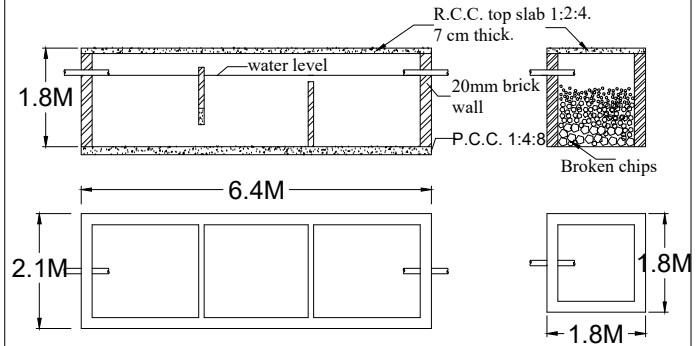


Section on A A



PLAN

DETAILS OF SEPTIC TANK AND SOCK PIT



KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION

DEVELOPMENT OF VIPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT VALAPPU BEACH

DRAWING NO:		ASSISTANT ENGINEER:		**ASSISTANT ENGINEER:** SIGNATURE:	**ASSISTANT EXECUTIVE ENGINEER:** SIGNATURE:
DATE:		DRAWN:			
TYPE:	**DRAWING**	**REVISION**		**STRUCTURAL CONSULTANT:** DESIGNED & CHECKED BY	**CHIEF ENGINEER:** SIGNATURE:
TITLE:	TOILET BLOCK	1.			
		2.			

ANNEXURE 2

Name of work : DEVELOPMENT OF VYPIN -MUNAMBAM COASTAL STRETCH- INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT MALIPPURAM

ESTIMATE REPORT

This estimate for development of fish landing centre and coastal protection at Malippuram based on the study conducted by IIT Madras for shore protection of Vypin to Munambam stretch in the Ernakulam district of Kerala, wherein groynes are proposed for coastal protection at Malippuram.In this estimate, a series of4 transitional groynes are proposed. This includes 2 T groynes and 2 normal groynes. A filter layer of 1kg to 10kg category stone, Core layer using 100 to 300 kg stones , Toe Mound using 500 to 800 kg stones , Armour layer using 1.5T to 2.5T stones proposed here. In addition to that 2T tetrapods at 1.96m Thick and 4T tetrapods at 2.50m Thick is provided for armour layer. Provision for Auction hall building of size 28.3m x 6.4m is included in the estimate. For the auction hall, coconut piling of length 6m long is provided for foundation. RCC M20 provided for foundations, centering & shuttering, Reinforcement cement concrete work(M20) in walls is provided for super structure. Necessary Steel reinforcement, plastering and painting works are also included in the Auction hall. Provision for construction of a toilet block of size 12.5m x 5.1m is also included in the estimate. For the toilet block, RR masonry with cement mortar 1:6 is provided for the foundation.Solid block masonry of size 30x20x15cm and 40x20x10cm are provided for super structure. Ceramic tiling is provided in the floor and in the bathroom region. Necessary fittings are also provided for toilet block. Other provisions in the estimate include concrete parking area proposed near the the Auction hall. Provision for the construction ofdrain is also included int he estimate. Lump sum provision for sub soil investigation, water supply and sanitary arrangement, Electrification and yard lighting are also included in the estimate. Lump sum provision for unforeseen expenses @2.5% are also included in the estimate. Total amount of estimate comes to Rupees 23,60,00000/-(Rupees Twenty three crore Sixty lakhs only) including 18% GST charges but excluding consultancy charges. The estimate is prepared in PRICE based on D SR 2018 and cost index is 35.59%. The provisions adopted in the estimate are adequate for proper completion of work.

INCLUDING COASTAL PROTECTION AND CONSTRACTION OF FISH LANDING CENTRE AT MALIPPURAM

COST ABSTRACT

1	*APPENDIX - A GROYNE*	*Rs.*	*18 13 68 224/-*
2	*APPENDIX B- CONSTRUCTION OF AUCTION HALL*	*Rs.*	*31 99 195/-*
3	*Appendix C- construction of Toilet block*	*Rs.*	*22 56 232/-*
4	*Appendix D- Parking Area*	*Rs.*	*39 04 172/-*
5	*Appendix E - Drain*	*Rs.*	*11 81 928/-*
6	*Sub soil investigation*	*Rs.*	*10 00 000/-*
7	*Water supply and sanitary arrangement*	*Rs.*	*11 00 000/-*
8	*Electrification and yard lighting*	*Rs.*	*10 00 000/-*
9	*Unforeseen expenses @ 2.5%*	*Rs.*	*49 40 000/-*
10	*Sub Total*	*Rs.*	*19 99 49 752/-*
11	*GST @ 18%*	*Rs.*	*3 59 90 955/-*
12	*Total Amount including GST 18%*	*Rs.*	*23 59 40 707/-*
13	*Lumpsum for Round off*	*Rs.*	*59 293/-*
14	*Total Amount*	*Rs.*	*23 60 00 000/-*
15	*Consultancy @5%*	*Rs.*	*1 18 00 000/-*
16	*GST on consultancy @ 18%*	*Rs.*	*21 24 000/-*
17	*Round off*	*Rs.*	*76 000/-*
18	*Grand Total*	*Rs.*	*25 00 00 000/-*

Rupees Twenty Five Crore Only

DEVELOPMENT OF VYPIN -MUNAMBAM COASTAL STRETCH- INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT MALIPPURAM

General Abstract

(Dsor year: **2018**,Cost Index Applied for this estimate is **35.59**%)

Sl No	Heading Description	Amount
1	**Appendix A- Groyne**	181368223.84
2	**Construction of Auction Hall**	3199194.95
3	**Appendix C - Construction of Toilet block**	2256232.44
4	**Appendix D- Parking Area**	3904172.44
5	**Appendix E- Drain**	1181928.31
6	**Subsoil Investigation**	1000000.00
7	**Water supply and sanitary arrangement**	1100000.00
8	**Electrification and yard lighting**	1000000.00
9	**Unforeseen expenses@2.5%**	4940000.00
	Provision for GST payments (in %) @	**18.0%**
	Amount reserved for GST payments	**35990955.36**
	Total	**235940707.36**
	Lumpsum for round off	**59292.64**
		TOTAL Rs 236000000.00
		Rounded Total Rs 23,60,00,000
		Rupees Twenty Three Crore Sixty Lakh Only

(Cost Index Applied for this estimate is 35.59%)

DEVELOPMENT OF VYPIN -MUNAMBAM COASTAL STRETCH- INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT MALIPPURAM

Detailed Estimate

(Dsor year: **2018**,Cost Index Applied for this estimate is **35.59**%)

Sl No	Description	No	L	B	D	CF	Quantity	Remark
	1 Appendix A- Groyne							
1	od199258/2023_2024 [Based on 65.32]Supplying blasted rock from approved quarry to sorting site and sorting the stones into 1.5T to 2.5T(70% of stones > 2.0T) category stones of approved quality having specific gravity ranges from 2.65 to 2.8 for forming the primary armour and berm of rubble mount breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and the measurements of catagorised stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater and forming the primary armour of the breakwater to the lines and levels as per approved drawings with tolerance of +/- 20 cm in final levels including all cost and labour charges, hire and operational charges of mobile crane and excavator, rehandling, placing and packing and using mobile crane, inspecting the profile once in a week and cost of spalls/quarry muck and hire of machineries for forming the roadway for movement of lorries/tippers/cranes etc including all incidental charges etc complete as per the direction of departmental officers at site Ernakulam District							
	Groyne-1							
	Chainage 0 to 60m	1	2712.690				2712.690	
	Groyne- 2							
	Chainage 0 to 120m	1	3875.300				3875.300	
	Groyne-3							
	Chainage 0 to 120m	1	3875.300				3875.300	
	Groyne- 4							
	Chainage 0 to 60m	1	2712.690				2712.690	
	Total Quantity						13175.980 tonne	
	Total Deducted Quantity						0.000 tonne	
	Net Total Quantity						13175.980 tonne	
	Say 13175.980 tonne @ Rs 1781.12 / tonne						**Rs 23468001.50**	
2	2.6.1 Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil							

	From Ch 0.00 to 40.00m	4	40.000	35.000	2.000		11200.000	
						Total Quantity	11200.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	11200.000 cum	
						Say 11200.000 cum @ Rs 214.03 / cum	**Rs 2397136.00**	
3	od199259/2023_2024 Supplying blasted rock from approved quarry to sorting site and sorting the stones into 500kg to 800kg category stones of approved quality having specific gravity ranges from 2.65 to 2.8 for forming the primary armour and berm of rubble mount breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and the measurements of catagorised stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater and forming the primary armour of the breakwater to the lines and levels as per approved drawings with tolerance of +/- 20 cm in final levels including all cost and labour charges, hire and operational charges of mobile crane and excavator, rehandling, placing and packing and using mobile crane, inspecting the profile once in a week and cost of spalls/quarry muck and hire of machineries for forming the roadway for movement of lorries/tippers/cranes etc including all incidental charges etc complete as per the direction of departmental officers at site Ernakulam District							
	Toe Mound using 500 to 800 kg stones (Assuming 1/3 void and sp.gravity 2.7)- Groyne 1							
	Chainage 0 to 60m	1	1466.450		1.050		1539.773	
	T Head(30m)	1	1981.690		1.050		2080.775	
	Head	2	459.860		1.050		965.706	
	Groyne- 2							
	Chainage 0 to 120m	1	4490.180		1.050		4714.689	
	Head	1	351.820		1.050		369.411	
	Groyne- 3							
	Chainage 0 to 120m	1	4490.180		1.050		4714.689	
	Head	1	485.070		1.050		509.324	
	Groyne- 4							
	Chainage 0 to 60m	1	1466.450		1.050		1539.773	
	T Head(30m)	1	1981.690		1.050		2080.775	
	Head	2	426.860		1.050		896.407	
						Total Quantity	19411.322 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	19411.322 tonne	

				Say 19411.322 tonne @ Rs 1781.12 / tonne			**Rs 34573893.84**	
4	od209107/2023_2024 [Based on 65.30]Supplying granite blasted rock from approved quarry to sorting site by lorry/ tipper, and sorting the stones into 100kg to 300kg category stones of approved quality having specific gravity ranging from 2.65 to 2.8 for forming the core of rubble mound breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and measurements of categorized stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater and rehandling and forming the core of the break water to the lines and levels as per the approved drawings and inspecting the profile once in a week with tolerance of +/- 20cm in final levels including all cost and labour charges, hire and operational charges of light crane and cost of spalls/ quarry muck and labour for forming the roadway for movement of lorries/ tippers / cranes etc including all incidental charges etc complete as per the direction of departmental officers at site Ernakulam District								
	Core layer using 100 to 300 kg stones (Assuming 1/3 void and sp.gravity 2.7)- Groyne 2							
	Chainage 0 to 60m	1	2828.870		1.100		3111.757	
	T Head(30m)	1	1374.080		1.100		1511.488	
	Head	2	282.960		1.100		622.512	
	Groyne- 2							
	Chainage 0 to 120m	1	5890.370		1.100		6479.407	
	Head	1	506.930		1.100		557.623	
	Groyne- 3							
	Chainage 0 to 120m	1	5890.370		1.100		6479.407	
	Head	1	314.970		1.100		346.468	
	Groyne-4							
	Chainage 0 to 60m	1	2828.870		1.100		3111.757	
	T Head(30m)	1	1374.080		1.100		1511.488	
	Head	2	235.400		1.100		517.881	
						Total Quantity	24249.788 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	24249.788 tonne	
				Say 24249.788 tonne @ Rs 1610.75 / tonne			**Rs 39060346.02**	
5	od209112/2023_2024 Supplying granite quarry run from approved quarry to sorting site by lorry/ tipper, and sorting the stones into 1 kg to 10 kg category stones of approved quality with specific gravity ranging from 2.65 to 2.8 for forming the filter layer of breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and the measurements of categorized stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software							

	having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater including conveyance from sorting platform and dumping stones using tippler (3.5x2.5 sqm size) or any suitable methods installed at site on a moving crane having a capaciaty of not less than 20T and placing the stones at sea bed in uniform layer of design thickness for forming filter layer of breakwater as per the approved drawing and design and inspecting the profile once in a week including hire and operational charges of T & P, tippler, crane and all incidental charges etc. complete as per the direction of departmental officers at site. Eranakulam District							
	Filter layer using 1 to 10 kg stones (Assuming 1/3 void and sp.gravity 2.7)- Groyne 1							
	Chainage 0 to 60m	1	871.140				871.140	
	T Head(30m)	1	511.430				511.430	
	Head	2	251.980				503.960	
	Groyne- 2							
	Chainage 0 to 120m	1	1856.210				1856.210	
	Head	1	291.110				291.110	
	Groyne- 3							
	Chainage 0 to 120m	1	1856.210				1856.210	
	Head	1	281.750				281.750	
	Groyne- 4							
	Chainage 0 to 60m	1	871.140				871.140	
	T Head(30m)	1	511.430				511.430	
	Head	2	238.990				477.980	
						Total Quantity	8032.360 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	8032.360 tonne	
						Say 8032.360 tonne @ Rs 1640.26 / tonne	**Rs 13175158.81**	
6	65.103 Moulding and supplying 0.8 cum(2T) tetrapod with graded aggregate of 40% 75mm to 40mm, 30% 40mm to 20mm and 30% 20mm to 6mm using 380kg cement/ m3 of concrete as per approved mix design of mix proportion 0.5:1:1. 46:3.22 by weight of water cement, fine aggregate, coarse aggregate (specific gravity of fine aggregate and coarse aggregate should not be less than 2.73 and 2.5 respectively) and the cement shall be 43 grade or higher) minimum cube strength requirement (i) @7 day - 20 N/mm2 (ii) @ 28 day - 30 N/mm2 and minimum density of concrete 2.5 g/cc including hire and operational charges of tools and plants, mould, curing, rehandling and stacking charges etc., complete as per the instruction of departmental officers at site .							
	ARMOUR LAYER, 2T tetrapods at 1.96m Thick	4485					4485.000	
						Total Quantity	4485.000 each	

						Total Deducted Quantity	0.000 each	
						Net Total Quantity	4485.000 each	
						Say 4485.000 each @ Rs 7596.47 / each	**Rs 34070167.95**	
7	65.104 Conveying 0.8cum (2T) tetrapod from stacking yard and placing in position in two layers according to specification and forming the armour layer of breakwater to lines and levels over the secondary armour layer including hire and operational charges of tools and plants etc., complete as per the direction of the departmental officers at site							
	ARMOUR LAYER, 2T tetrapods at 1.96m Thick	4485					4485.000	
						Total Quantity	4485.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	4485.000 each	
						Say 4485.000 each @ Rs 912.92 / each	**Rs 4094446.20**	
8	od199256/2023_2024 Moulding and supplying cement concrete 1.6m3 (4T) tetrapod with graded aggregate of 40% 75mm to 40 mm, 30% 40 to 20mm, 30% 20 to 5mm using 380 kg cement /m3 pf cpmcrete as per approved mix design of mix proportion 0.5:,1.46:3.22 by weight of water cement, fine aggregate, course aggregate (specific gravity of fine aggregate and course aggregateshould not be less than 2.73 and 2.5 respectively) and the cement shall be 43 grade or higher) minimum cube strength requirement (i) @ 7 day - 20N/mm2 (ii) @ 28 day - 30N/mm2 and minimum density of concrete 2.5 g/cc. including hire and operational charge of tools and plants moulding and rehandling and stacking charge etc complete according to specification and instructions of Engineer							
	ARMOUR LAYER, 4T tetrapods at 2.50m Thick	1615					1615.000	
						Total Quantity	1615.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	1615.000 each	
						Say 1615.000 each @ Rs 15999.39 / each	**Rs 25839014.85**	
9	od199266/2023_2024 Conveying 1.6m3 (4T) tetrapods from stacking and placing in two layer according to specification and forming the armour layer of reak water to lines and levels at depth of water 8m and above including hire and operational charges of tools and plants etc complete							
	ARMOUR LAYER, 4T tetrapods at 2.50m Thick	1615					1615.000	
						Total Quantity	1615.000 each	

						Total Deducted Quantity	0.000 each	
						Net Total Quantity	1615.000 each	
						Say 1615.000 each @ Rs 2042.97 / each	**Rs 3299396.55**	
10	od199265/2023_2024 Supplying and laying Geotextile 120 gram per sqm membrane (best quality) including providing necessary overlaps, all cost, conveyance, labour charges etc complete as per the instruction of departmental officers at site.							
	Groyne- 1							
	Chainage 0 to 60m	1	60.000		40.000		2400.000	
	T Head(30m)	1	30.000		40.000		1200.000	
	Groyne- 2							
	Chainage 0 to 120m	1	120.000	40.000			4800.000	
	Groyne- 3							
	Chainage 0 to 120m	1	4490.180		1.050		4714.689	
	Groyne- 4							
	Chainage 0 to 60m	1	60.000	40.000			2400.000	
	T Head(30m)	1	30.000	40.000			1200.000	
						Total Quantity	16714.689 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	16714.689 sqm	
						Say 16714.689 sqm @ Rs 83.20 / sqm	**Rs 1390662.12**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
2 Construction of Auction Hall								
1	2.8.1 Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil							
	column footing	16	2.100	2.100	1.900		134.064	
	below out side plinth beam	2*7	3.700	0.450	0.600		13.986	
	cross beam	2	5.800	0.450	0.600		3.132	
		1	3.818				3.818	
						Total Quantity	155.000 cum	
						Total Deducted Quantity	0.000 cum	

						Net Total Quantity	155.000 cum	
						Say 155.000 cum @ Rs 296.94 / cum	**Rs 46025.70**	
2	od199352/2023_2024 Supplying and stacking good quality coconut piles							
	For pile 16 x5 Nos =80 Nos	80	6.000				480.000	
						Total Quantity	480.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	480.000 metre	
						Say 480.000 metre @ Rs 107.64 / metre	**Rs 51667.20**	
3	od199370/2023_2024 Coconut Pile- Driving down coconut pile to lines and levels through soft to medium clay soil strata including all hire charges and labour for fixing, staging platform and all other appliances necessary for pile driving down after pointing the bottom end. Details of one post of 6m long 15 numbers per day 6x15=90m.							
	For pile	80	6.000				480.000	
						Total Quantity	480.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	480.000 metre	
						Say 480.000 metre @ Rs 216.92 / metre	**Rs 104121.60**	
4	od199380/2023_2024 Cutting and removing the excess length of wooden piles to lines and levels and removing the cut end of piles and stacking within 150m							
	excess length of pile	80					80.000	
						Total Quantity	80.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	80.000 metre	
						Say 80.000 metre @ Rs 154.21 / metre	**Rs 12336.80**	
5	2.18.1 Close timbering over areas including strutting, shoring and packing cavities (wherever required) etc. complete (Measurements to be taken of the face area timbered):Depth not exceeding 1.5 m							
	column excavation side	16*4	2.000	1.200			153.600	
	round of	1	1.400				1.400	
						Total Quantity	155.000 sqm	
						Total Deducted Quantity	0.000 sqm	

						Net Total Quantity	155.000 sqm	
						Say 155.000 sqm @ Rs 136.88 / sqm	**Rs 21216.40**	
6	od199892/2023_2024 Providing and laying filter media with granular crushed aggregates as per specification to a thickness of not less than 600 mm with smaller size towards the soil and bigger size towards the wall and providing over the entire surface behind abutment, wing wall, return wall to the full height, compacted to firm condition complete as per drawing and technical specification Clause 1204.3.8 of MoRD ncluding cost of all materials ,conveyance,labour charges, etc. complete 							
	bottom of column footing	16	1.900	1.900	0.300		17.328	
	rounded	1	0.672				0.672	
						Total Quantity	18.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	18.000 cum	
						Say 18.000 cum @ Rs 1679.73 / cum	**Rs 30235.14**	
7	50.2.3.1 Pumping or Bailing out water and removing slush etc by using pump set including cost of labour, oil hire charges of pumpset, etc complete							
	For earth work 16 column	2	8.000				16.000	
	For coconut pilling	1	8.000				8.000	
	cc for footing & soling	1	8.000				8.000	
	reinforcement work,shuttering@ concrete for footing	4	8.000				32.000	
						Total Quantity	64.000 hour	
						Total Deducted Quantity	0.000 hour	
						Net Total Quantity	64.000 hour	
						Say 64.000 hour @ Rs 284.60 / hour	**Rs 18214.40**	
8	4.1.8 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)							
	column C1 to C16	16	1.700	1.700	0.200		9.248	
	below plinth beam	2*7	3.700	0.450	0.100		2.331	
	cross beam	8	5.600	0.450	0.100		2.016	
	AH floor	7	5.700	3.700	0.150		22.145	

	rounded	1	0.260				0.260	
						Total Quantity	36.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	36.000 cum	
						Say 36.000 cum @ Rs 6814.89 / cum	**Rs 245336.04**	
9	5.1.2 Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level:1:1:5:3 (1 cement 1.5 coarse sand :3 graded stone aggregate 20 mm nominal size							
	column footing C1 to C16	16	1.500	1.500	0.300		10.800	
		16	((1.5*1.5)+(.4*.3))/2		0.300		5.688	
	column up to plinth	16	0.300	0.400	1.000		1.920	
	rounded	1	0.592				0.592	
						Total Quantity	19.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	19.000 cum	
						Say 19.000 cum @ Rs 9085.14 / cum	**Rs 172617.66**	
10	5.2.2 Reinforced cement concrete work in walls (any thickness), including attached pilasters, buttresses, plinth and string courses, fillets, columns, pillars, piers, abutments, posts and struts etc. up tot floor five level excluding cost of centering, shuttering, finishing and reinforcement :1:1.5:3(1 cement : 1.5 coarse sand : 3 graded stone aggregate 20 mm nominal size)							
	plinth beam	2	28.300	0.300	0.300		5.094	
	-do-	8	5.800	0.300	0.400		5.569	
	column up to beam C1 to C16	16	0.400	0.300	4.000		7.680	
	roof beam long	2	28.300	0.300	0.350		5.943	
	inglind beam	2*8	3.200	0.300	0.350		5.376	
	roof slab	2	29.500	4.550	0.120		32.214	
	rounded	1	0.124				0.124	
						Total Quantity	62.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	62.000 cum	
						Say 62.000 cum @ Rs 10954.04 / cum	**Rs 679150.48**	

11	5.9.1 Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete							
	Column base	16*4	1.500	0.300			28.800	
	Column up to plinth	16*2	0.400	1.100			14.081	
		16*2	0.300	1.100			10.560	
	rounded	1	0.559				0.559	
						Total Quantity	54.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	54.000 sqm	
						Say 54.000 sqm @ Rs 335.31 / sqm	**Rs 18106.74**	
12	5.9.5 Centering and shuttering including strutting, etc. and removal of form for:Lintels, beams, plinth beams, girders bressumers and cantilevers							
	plinth beam out side	2	28.300	0.300			16.980	
	plinth beam in side	2*7	3.700	0.300			15.541	
	cross beam	8*2	5.800	0.400			37.120	
	roof beam out side	2	28.300	0.300			16.980	
	roof beam in side	2*7	3.700	0.400			20.721	
	roof beam bottom	2*7	3.700	0.300			15.541	
	inglind beam side	2*8*2	3.200	0.350			35.840	
	inglind beam bottom	8*2	3.200	0.300			15.360	
	rounded	1	0.917				0.917	
						Total Quantity	175.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	175.000 sqm	
						Say 175.000 sqm @ Rs 649.82 / sqm	**Rs 113718.50**	
13	5.9.3 Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform							
	roof slab bottom	2*7	3.700	3.200			165.761	
	side projection	2*2	4.500	0.600			10.800	
	slab projection	2	29.500	1.000			59.000	
	slab projection side	2	29.500	0.120			7.080	
	end side	2*2	4.500	0.120			2.160	

	rounded	1	5.199				5.199	
						Total Quantity	250.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	250.000 sqm	
						Say 250.000 sqm @ Rs 815.78 / sqm	**Rs 203945.00**	
14	5.9.6 Centering and shuttering including strutting, etc. and removal of form for:Columns, Pillars, Piers, Abutments, Posts and Struts							
	column C1 to C16	16*2	0.400	4.000			51.200	
		16*2	0.300	4.000			38.400	
	rounded	1	0.400				0.400	
						Total Quantity	90.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	90.000 sqm	
						Say 90.000 sqm @ Rs 863.64 / sqm	**Rs 77727.60**	
15	5.22.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more							
	For column footing	1	16.580			100.0	1658.000	@100kg/ m3
	column up to plinth	1	1.800			120.0	216.000	@120kg/ m3
	rounded	1	6.000				6.000	@120kg/ m3
						Total Quantity	1880.000 kilogram	
						Total Deducted Quantity	0.000 kilogram	
						Net Total Quantity	1880.000 kilogram	
						Say 1880.000 kilogram @ Rs 98.30 / kilogram	**Rs 184804.00**	
16	5.22A.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Thermo - Mechanically Treated bars of grade Fe-500D or more							
	plinth beam	2	28.300	0.300	0.300	100.0	509.401	@100kg/ m3
	-do-	8	5.800	0.300	0.400	100.0	556.801	@100kg/ m3

	column up to beam C1 to C16	16	0.400	0.300	4.000	100.0	768.000	@100kg/ m3
	roof beam long	2	28.300	0.300	0.350	100.0	594.300	@100kg/ m3
	inglind beam	2*8	3.200	0.300	0.350	100.0	537.600	@100kg/ m3
	roof slab	2	29.500	4.550	0.120	100.0	3221.400	@100kg/ m3
	rounded	1	12.498				12.498	
						Total Quantity	6200.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	6200.000 kg	
						Say 6200.000 kg @ Rs 98.30 / kg	**Rs 609460.00**	
17	7.1.1 Random rubble masonry with hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 (1 cement : 6 coarse sand : 12 graded stone aggregate 20 mm nominal size) up to plinth level with:Cement mortar 1:6 (1 cement : 6 coarse sand)							
	below out side plinth beam	2*7	3.700	0.450	0.600		13.986	
	below cross beam	2	5.800	0.450	0.600		3.132	
	rounded	1	0.882				0.882	
						Total Quantity	18.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	18.000 cum	
						Say 18.000 cum @ Rs 7204.78 / cum	**Rs 129686.04**	
18	2.25 Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.							
	in betwen plinth beams	7	5.700	3.700	0.300		44.290	
	Back filling footing trenches	16	3.000				48.000	@ 3m3/ one column
	rounded	1	2.710				2.710	@ 3m3/ one column
						Total Quantity	95.000 cum	

						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	95.000 cum	
						Say 95.000 cum @ Rs 258.57 / cum	**Rs 24564.15**	
19	13.7.1 12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)							
	For the roof slabs. Top	2	29.500	4.550			268.450	
	side	2	29.500	0.130			7.670	
	end side	2	9.050	0.130			2.353	
	rounded	1	1.527				1.527	
						Total Quantity	280.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	280.000 sqm	
						Say 280.000 sqm @ Rs 401.21 / sqm	**Rs 112338.80**	
20	13.16.1 6 mm cement plaster of mix:1:3 (1 cement : 3 fine sand)							
	For cross beams side	2*8	6.200	0.350			34.720	
	bottom	8	6.200	0.300			14.880	
	long beam in side	2*7	3.700	0.400			20.721	
	long beam out side	2	28.300	0.300			16.980	
	bottom	2*7	3.700	0.300			15.541	
	slab bottom	2*7	3.700	3.200			165.761	
	roof projection end	2	4.500	0.600			5.400	
	out side beam projection side	2	29.500	1.050			61.950	
	column C1 to C16	16	4.000	1.400			89.600	
	rounded	1	4.447				4.447	
						Total Quantity	430.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	430.000 sqm	
						Say 430.000 sqm @ Rs 267.59 / sqm	**Rs 115063.70**	
21	13.4.1 12 mm cement plaster of mix:1:4 (1 cement : 4 coarse sand)							
	Auction hall floor	1		28.300	6.400		181.120	

	rounded	1		3.880			3.880	
						Total Quantity	185.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	185.000 sqm	
						Say 185.000 sqm @ Rs 325.01 / sqm	**Rs 60126.85**	
22	13.43.1 Applying one coat of water thinnable cement primer of approved brand and manufacture on wall surface:Water thinnable cement primer							
	roof beam side & bottom	8	6.200	1.000			49.600	
	long beam out side	2	28.300	0.400			22.640	
	inside	2*7	3.700	0.400			20.721	
	bottom	2*7	3.700	0.300			15.541	
	slab bottom	2*7	3.700	3.200			165.761	
	roff projection end	2*2	4.500	0.600			10.800	
	roff projection side	2	29.500	1.050			61.950	
	column	16	4.000	1.400			89.600	
	side end	2	9.050	0.130			2.353	
	projection side	2	29.500	0.130			7.670	
	top of roof slab	2	29.500	4.550			268.450	
		1	4.914				4.914	
						Total Quantity	720.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	720.000 sqm	
						Say 720.000 sqm @ Rs 70.64 / sqm	**Rs 50860.80**	
23	13.44.1 Finishing walls with water proofing cement paint of required shade:New work (Two or more coats applied @ 3.84 kg/10 sqm)							
	slab bottom	2*7	3.700	3.200			165.761	
	roof projection end	2	9.000	0.600			10.800	
	roof projection side	2	29.500	1.050			61.950	
	round of	1	1.489				1.489	
						Total Quantity	240.000 sqm	
						Total Deducted Quantity	0.000 sqm	

						Net Total Quantity	240.000 sqm	
						Say 240.000 sqm @ Rs 107.39 / sqm	**Rs 25773.60**	
24	13.46.1 Finishing walls with Acrylic Smooth exterior paint of required shade:New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm)							
	roof beam allround	8	6.200	1.000			49.600	
	long beam out side	2	28.300	0.300			16.980	
	long beam in side	2*7	3.700	0.400			20.721	
	bottom	2*7	3.700	0.300			15.541	
	column C1 to C16	16	4.000	1.400			89.600	
	top of roof slab	2	29.500	4.550			268.450	
	side	2	29.500	0.130			7.670	
	side end	2	9.050	0.130			2.353	
	round off	1	4.085				4.085	
						Total Quantity	475.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	475.000 sqm	
						Say 475.000 sqm @ Rs 193.89 / sqm	**Rs 92097.75**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
	3 Appendix C - Construction of Toilet block							
1	2.8.1 Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil							
	toilet block foundation all round	1	35.500	0.800	0.750		21.300	
	crosswall long	2	11.500	0.800	0.750		13.800	
	cross	1	6.050	0.800	0.750		3.630	
		1	3.150	0.800	0.750		1.891	
	bath room	1	4.800	0.800	0.750		2.880	
	step	1	3.500	1.200	0.600		2.520	
	ramp	2	4.500	0.800	0.750		5.400	
		1	3.000	0.800	0.750		1.801	
	tank	1	6.700	2.400	2.000		32.160	

	sock pit	1	1.800	1.800	1.500		4.860	
		1	4.758				4.758	
						Total Quantity	95.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	95.000 cum	
						Say 95.000 cum @ Rs 296.94 / cum	**Rs 28209.30**	
2	2.26.1 Extra for every additional lift 1.5 m or part there of in excavation / banking excavated or stacked materials.All kinds of soil							
	tank	1	6.700	2.400	0.500		8.040	
		1	1.960				1.960	
						Total Quantity	10.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	10.000 cum	
						Say 10.000 cum @ Rs 106.37 / cum	**Rs 1063.70**	
3	4.1.8 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)							
	toilet block foundation all round	1	35.500	0.800	0.150		4.260	
	crosswall long	2	11.500	0.800	0.150		2.761	
	cross	1	6.050	0.800	0.150		0.726	
		1	3.150	0.800	0.150		0.378	
	bath roo	1	4.800	0.800	0.150		0.576	
	step	1	3.500	1.200	0.150		0.630	
	ramp	2	4.500	0.800	0.150		1.080	
		1	3.000	0.800	0.150		0.361	
	floor room	1	12.150	4.800	0.100		5.833	
	ramp& varandha	1	13.500	1.200	0.100		1.620	
	tank	1	6.700	2.400	0.200		3.216	
		1	0.559				0.559	
						Total Quantity	22.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	22.000 cum	

					Say 22.000 cum @ Rs 6814.89 / cum		**Rs 149927.58**	
4	7.1.1 Random rubble masonry with hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 (1 cement : 6 coarse sand : 12 graded stone aggregate 20 mm nominal size) up to plinth level with:Cement mortar 1:6 (1 cement : 6 coarse sand)							
	toilet block foundation all round	1	35.500	0.600	0.600		12.780	
	crosswall long	2	11.500	0.600	0.600		8.280	
	cross	1	6.050	0.600	0.600		2.178	
		1	3.150	0.600	0.600		1.134	
	bath room	1	4.800	0.600	0.600		1.728	
	ramp	2	4.500	0.600	0.600		3.240	
		1	3.000	0.600	0.600		1.080	
	step	1	3.500	1.200	0.450		1.891	
	basement allround	1	35.500	0.450	0.450		7.189	
	cross	2	11.500	0.450	0.450		4.658	
		1	6.050	0.450	0.450		1.226	
		1	3.150	0.450	0.450		0.638	
	bath	1	4.800	0.450	0.450		0.973	
	ramp	2	3.150	0.450	0.300		0.851	
		1	3.000	0.450	0.450		0.608	
	partition	10	1.500	0.450	0.450		3.038	
	round	1	0.508				0.508	
						Total Quantity	52.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	52.000 cum	
						Say 52.000 cum @ Rs 7204.78 / cum	**Rs 374648.56**	
5	2.25 Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.							
	for foundation	1	11.550	3.900	0.600		27.027	
	varandha	1	7.000	0.750	0.600		3.150	
	rounded	1	4.823				4.823	
						Total Quantity	35.000 cum	

						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	35.000 cum	
						Say 35.000 cum @ Rs 258.57 / cum	**Rs 9049.95**	
6	5.2.2 Reinforced cement concrete work in walls (any thickness), including attached pilasters, buttresses, plinth and string courses, fillets, columns, pillars, piers, abutments, posts and struts etc. up tot floor five level excluding cost of centering, shuttering, finishing and reinforcement :1:1.5:3(1 cement : 1.5 coarse sand : 3 graded stone aggregate 20 mm nominal size)							
	basement allround	1	35.500	0.450	0.100		1.598	
	cross	1	11.500	0.450	0.100		0.518	
		1	6.050	0.450	0.100		0.273	
		1	3.150	0.450	0.100		0.142	
	bath	1	4.800	0.450	0.100		0.217	
	ramp	1	3.150	0.450	0.100		0.142	
		1	3.000	0.450	0.100		0.135	
	partition	10	1.500	0.450	0.100		0.675	
	lintel	1	76.000	0.150	0.150		1.710	
	roof slab	1	12.750	5.800	0.120		8.874	
	slop	1	39.450	1.000	0.120		4.734	
	tank bottom	1	6.000	2.100	0.150		1.891	
	beam	1	2.100	0.200	0.200		0.085	
	cover slab	1	6.000	2.100	0.120		1.512	
		1	1.800	1.800	0.120		0.389	
	rounded	1	0.105				0.105	
						Total Quantity	23.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	23.000 cum	
						Say 23.000 cum @ Rs 10954.04 / cum	**Rs 251942.92**	
7	5.22A.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Thermo - Mechanically Treated bars of grade Fe-500D or more							
	qty of cc	1	22.895			100.0	2289.500	100kg/m3
	rounded	1	10.500				10.500	100kg/m3
						Total Quantity	2300.000 kg	
						Total Deducted Quantity	0.000 kg	

						Net Total Quantity	2300.000 kg	
						Say 2300.000 kg @ Rs 98.30 / kg	**Rs 226090.00**	
8	5.9.3 Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform							
	basement	2	35.500	0.100			7.101	
	cross	2	11.500	0.100			2.301	
		2	6.050	0.100			1.210	
		2	3.150	0.100			0.630	
	bath	2	4.800	0.100			0.960	
	ramp	2	3.150	0.100			0.630	
		2	3.000	0.100			0.601	
	partition	10*2	1.500	0.100			3.001	
	lintel	2	76.000	0.150			22.800	
	roof slab	1	12.750	5.800			73.950	
	slop	1	39.450	1.000			39.450	
	tank bottom	4	10.200	0.150			6.120	
	beam	1	2.100	0.600			1.260	
	cover slab	12	5.100	0.120			7.344	
		3	4.800	0.120			1.728	
	rounded	1	0.914				0.914	
						Total Quantity	170.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	170.000 sqm	
						Say 170.000 sqm @ Rs 815.78 / sqm	**Rs 138682.60**	
9	50.6.2.2 Solid masonry using pre cast solid blocks (factory made) of size 30x20x15cm or nearest available size confirming to IS 2185 part I of 1979 for super structure up to floor two level with thickness 15cm in : CM 1:6 (1 cement : 6 coarse sand) etc complete							
	wall all round	1	34.500	2.800	0.150		14.490	
	cross wall	1	12.150	2.800	0.150		5.103	
	centre cross	1	3.150	2.800	0.150		1.323	
		1	6.050	2.800	0.150		2.541	
	bath	1	4.800	2.800	0.150		2.016	

	tank	1	16.200	1.800	0.200		5.833	
	step	1	3.000	0.600	0.450		0.810	
	rounded	1	0.593				0.593	
	shutter	1	3.000	2.400	0.150		-1.079	
	door	2	1.000	2.100	0.150		-0.630	
						Total Quantity	32.709 cum	
						Total Deducted Quantity	-1.709 cum	
						Net Total Quantity	31.000 cum	
						Say 31.000 cum @ Rs 6984.85 / cum	**Rs 216530.35**	
10	50.6.3.2 Solid block masonry using pre cast solid blocks (Factory made) of size 40x20x10 cm or nearest available size confirming to IS 2185 part I of 1979 for super structure up to floor two level for 10 cm thick wall in : CM 1:6 (1 cement : 6 coarse sand) including cost of scaffolding complete							
	toilet partition	10	1.500	2.800	0.100		4.200	
	urinal partition	2	1.000	1.400	0.100		0.280	
	parapet	1	37.100	0.600	0.100		2.227	
	seititank partition	2	1.700	1.000	0.100		0.340	
	sock pit	4	1.700	1.200	0.100		0.817	
	rounded	1	0.459				0.459	
	door	9	0.700	2.100	0.100		-1.323	
						Total Quantity	8.323 cum	
						Total Deducted Quantity	-1.323 cum	
						Net Total Quantity	7.000 cum	
						Say 7.000 cum @ Rs 7823.61 / cum	**Rs 54765.27**	
11	13.1.1 12 mm cement plaster of mix:1:4 (1 cement : 4 fine sand)							
	out side wall	1	35.300	2.800			98.840	
	Parapet	1	37.100	1.400			51.940	
	toilet inside	10	5.400	2.800			151.200	
	DA toilet	2	6.600	2.800			36.960	
	out	2	4.800	2.800			26.880	
	bath	1	6.500	2.800			18.200	
	partition	2	3.150	2.800			17.640	
		1	5.300	2.800			14.840	

		1	5.500	2.800			15.400	
		1	3.200	2.800			8.960	
		1	4.850	2.800			13.580	
		1	2.500	2.800			7.000	
	urinal partition	2	2.100	1.500			6.301	
	under side slab	1	12.750	5.800			73.950	
		1	39.450	1.000			39.450	
	rounded	1	5.927				5.927	
	door d	2	1.000	2.100			-4.200	
	toilet door	11	0.700	2.100			-16.169	
	ventilator	15	0.600	0.500			-4.500	
	shutter	1	3.000	2.400			-7.199	
						Total Quantity	587.068 sqm	
						Total Deducted Quantity	-32.068 sqm	
						Net Total Quantity	555.000 sqm	
						Say 555.000 sqm @ Rs 314.09 / sqm	**Rs 174319.95**	
12	13.7.1 12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)							
	slab top	1	12.750	5.800			73.950	
		1	39.450	1.000			39.450	
	rounded	1	1.600				1.600	
						Total Quantity	115.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	115.000 sqm	
						Say 115.000 sqm @ Rs 401.21 / sqm	**Rs 46139.15**	
13	13.7.2 12 mm cement plaster finished with a floating coat of neat cement of mix:1:4 (1 cement : 4 fine sand)							
	Septy tank inside	1	15.400	1.800			27.721	
	bottom	1	6.000	1.700			10.200	
	partition wall	2*2	1.700	1.000			6.800	
	rounded	1	0.279				0.279	
						Total Quantity	45.000 sqm	
						Total Deducted Quantity	0.000 sqm	

						Net Total Quantity	45.000 sqm	
						Say 45.000 sqm @ Rs 386.36 / sqm	**Rs 17386.20**	
14	8.31 Providing and fixing Ist quality ceramic glazed wall tiles conforming to IS: 15622(thickness to be specified by the manufacturer), of approved make, in all colours,shades except burgundy, bottle green, black of any size as approved by Engineerin-Charge,in skirting, risers of steps and dados, over 12 mm thick bed of cementmortar 1:3 (1 cement : 3 coarse sand) and jointing with grey cement slurry @3.3kg per sqm, including pointing in white cement mixed with pigment of matchingshade complete.							
	toilet	11	4.700	1.800			93.060	
	DA toilet	2	5.600	1.800			20.160	
	bath	1	5.800	1.800			10.440	
	urinal portion	3	2.600	1.600			12.480	
	rounded	1	3.860				3.860	
						Total Quantity	140.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	140.000 sqm	
						Say 140.000 sqm @ Rs 1212.78 / sqm	**Rs 169789.20**	
15	11.37 Providing and laying Ceramic glazed floor tiles of size 300x300 mm (thickness to be specified by the manufacturer), of 1st quality conforming to IS : 15622, of approved make, in colours such as White, Ivory, Grey, Fume Red Brown, laid on 20 mm thick cement mortar 1:4 (1 Cement : 4 Coarse sand), including pointing the joints with white cement and matching pigment etc., complete.							
	inside floor	1	12.150	4.800			58.320	
	rounded	1	1.680				1.680	
						Total Quantity	60.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	60.000 sqm	
						Say 60.000 sqm @ Rs 1091.02 / sqm	**Rs 65461.20**	
16	od204530/2023_2024 :Providing and laying industrial grade antiskid tiles of size 300x300mm with thickness 9mm or nearest with water absorption less than 0.08 % and conforming to I.S. 15622, of approved make, in all colours & shades,laid on 20 mm thick cement mortar 1:4 (1 cement : 4 coarse sand), including grouting the joint with white cement & matching pigments etc. complete.							
	ramp	2	5.200	1.200			12.480	
		1	3.500	1.200			4.200	
	step	3	3.000	0.450			4.051	
	round	1	2.269				2.269	

						Total Quantity	23.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	23.000 sqm	
						Say 23.000 sqm @ Rs 1276.95 / sqm	**Rs 29369.85**	
17	13.43.1 Applying one coat of water thinnable cement primer of approved brand and manufacture on wall surface:Water thinnable cement primer							
	area vide item no 11	1	555.000				555.000	
						Total Quantity	555.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	555.000 sqm	
						Say 555.000 sqm @ Rs 70.64 / sqm	**Rs 39205.20**	
18	13.46.1 Finishing walls with Acrylic Smooth exterior paint of required shade:New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm)							
	out side wall	1	35.300	2.800			98.840	
	Parapet	1	37.100	1.400			51.940	
	rounded	1	4.220				4.220	
						Total Quantity	155.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	155.000 sqm	
						Say 155.000 sqm @ Rs 193.89 / sqm	**Rs 30052.95**	
19	13.83.2 Wall painting with premium acrylic emulsion paint of interior grade, having VOC (Volatile including applying additional coats wherever required to achieve even shade and colour.Two coats							
	toilet inside	10	5.400	1.000			54.000	
	DA toilet	2	6.600	1.000			13.200	
	out	2	4.800	2.800			26.880	
	bath	1	6.500	1.000			6.500	
	partition	2	3.150	2.800			17.640	
		1	5.300	2.800			14.840	
		1	5.500	2.800			15.400	
		1	3.200	2.800			8.960	
		1	4.850	2.800			13.580	
		1	2.500	2.800			7.000	

	urinal partition	2	2.100	1.500			6.301	
	under side slab	1	12.750	5.800			73.950	
		1	39.450	1.000			39.450	
	rounded	1	4.367				4.367	
	door d	2	1.000	2.100			-4.200	
	toilet door	11	0.700	2.100			-16.169	
	ventilator	15	0.600	0.500			-4.500	
	shutter	1	3.000	2.400			-7.199	
						Total Quantity	302.068 sqm	
						Total Deducted Quantity	-32.068 sqm	
						Net Total Quantity	270.000 sqm	
						Say 270.000 sqm @ Rs 134.10 / sqm	**Rs 36207.00**	
20	9.117.1 Providing and fixing factory made uPVC door frame made of uPVC extruded sections having an overall dimension as below (tolerance ±1 mm), with wall thickness 2.0mm (±0.2 mm), corners of the door frame to be jointed with galvanized brackets and stainless steel screws, joints mitred and plastic welded. The hinge side vertical of the frames reinforced by galvanized M.S. tube of size 19 x 19 mm and 1 mm (± 0.1 mm) wall thickness and 3 nos. stainless steel hinges fixed to the frame complete as per manufacturer's specification and direction of Engineer-in-chargeExtruded section profile size 48x40 mm							
	Toilet door 70x210	11	5.600				61.600	
	DA toilet,100x210	2	6.200				12.400	
	rounded	1	1.000				1.000	
						Total Quantity	75.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	75.000 metre	
						Say 75.000 metre @ Rs 260.94 / metre	**Rs 19570.50**	
21	9.118.1 Providing and fixing to existing door frames24 mm thick factory made PVC door shutters made of styles and rails of a uPVC hollow section of size 59x24 mm and wall thickness 2 mm (± 0.2 mm) with inbuilt edging on both sides. The styles and rails mitred and joint at the corners by means of M.S. galvanised/plastic brackets of size 75x220 mm having wall thickness 1.0 mm and stainless steel screws. The styles of the shutter reinforced by inserting galvanised M.S. tube of size 20x20 mm and 1 mm (± 0.1 mm) wall thickness. The lock rail made up of 'H' section, a uPVC hollow section of size 100x24 mm and 2 mm (± 0.2 mm) wall thickness,fixed to the shutter styles by means of plastic/galvanised M.S. 'U' cleats. The shutter frame filled with a uPVC multi-chambered single panel of size not less than 620 mm, having over all thickness of 20 mm and 1 mm (± 0.1 mm) wall thickness. The panels filled vertically and tie bar at two places by inserting horizontally 6 mm galvanised M.S. rod and fastened with nuts and washers, complete as per manufacturer's specification and direction of Engineer-in-charge(For W.C. and							

	bathroom door shutter).							
	Toilet door 70x210	11	0.700	2.100			16.170	
	DA toilet,100x210	2	1.000	2.100			4.200	
	rounded	1	0.630				0.630	
						Total Quantity	21.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	21.000 sqm	
						Say 21.000 sqm @ Rs 2072.49 / sqm	**Rs 43522.29**	
22	9.147B.1 543SUB HEAD : 9 - WOOD & PVC WORK9.147BProviding and fixing factory made uPVC white colour fixed glazed windows/ventilators comprising of uPVC multi-chambered frame and mullion (where everrequired) extruded profiles duly reinforced with 1.60 ± 0.2 mm thick galvanizedmild steel section made from roll forming process of required length (shape &size according to uPVC profile), , uPVC extruded glazing beads of appropriatedimension, EPDM gasket, G.I fasteners 100 x 8 mm size for fixing frame to finishedwall, plastic packers, plastic caps and necessary stainless steel screws etc.Profile of frame shall be mitred cut and fusion welded at all corners, mullion (ifrequired) shall be also fusion welded including drilling of holes for fixinghardware's and drainage of water etc. After fixing frame the gap between frameand adjacent finished wall shall be filled with weather proof silicon sealant overbacker rod of required size and of approved quality, all complete as per approveddrawing & direction of Engineer-in-Charge. (Single / double glass panes andsilicon sealant shall be paid separately). Note: For uPVC frame, sash and mullion extruded profiles minus 5% tolerancein dimension i.e. in depth & width of profile shall be acceptable.Fixed window / ventilator made of (small series) frame 47 x 50 mm & mullion 47x 68 mm both having wall thickness of 1.9 ± 0.2 mm and single glazing bead ofappropriate dimension. (Area upto 0.75 sqm.)							
	for ventilator	15	0.600	0.500			4.500	
						Total Quantity	4.500 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	4.500 sqm	
						Say 4.500 sqm @ Rs 7626.06 / sqm	**Rs 34317.27**	
23	10.3 Providing and fixing in position collapsible steel shutters with vertical channels 20x10x2 mm and braced with flat iron diagonals 20x5 mm size, with top and bottom rail of T-iron 40x40x6 mm, with 40 mm dia steel pulleys, complete with bolts, nuts,locking arrangement, stoppers, handles, including applying a priming coat of approved steel primer .							
	Front shutter	1	3.500	2.400			8.400	
	rounded	1	0.600				0.600	
						Total Quantity	9.000 sqm	
						Total Deducted Quantity	0.000 sqm	

						Net Total Quantity	9.000 sqm	
						Say 9.000 sqm @ Rs 10205.93 / sqm	**Rs 91853.37**	
24	10.28 Providing and fixing stainless steel (Grade 304) railing made of Hollow tubes, channels, plates etc., including welding, grinding, buffing, polishing and making curvature (wherever required) and fitting the same with necessary stainless steel nuts and bolts complete, i/c fixing the railing with necessary accessories & stainless steel dash fasteners, stainless steel bolts etc., of required size on the top of the floor or the side of waist slab with suitable arrangement as per approval of Engineer-in-charge, (for payment purpose only weight of stainless steel members shall be considered excluding fixing accessories such as nuts, bolts, fasteners etc.)							
	hand rail	2	6.000				12.000	
						Total Quantity	12.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	12.000 kg	
						Say 12.000 kg @ Rs 677.34 / kg	**Rs 8128.08**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
	4 Appendix D- Parking Area							
1	16.78.1 Construction of granular sub- base by Providing close graded Material conforming to specifications, mixing in a mechanical mix plant at OMC, Carriage of mixed material by tippers to work site, for all leads & lifts, spreading in uniform layers of specified thickness with motor grader on prepared surface and compacting with vibratory power roller to achieve the desired density, complete as per specifications and directions of Engineer-in- Charge.With Material conforming to Grade - I (size range 75 mm to 0.075 mm) having CBR Value- 30							
	Auction hall front	1	40.000	20.000	0.150		120.000	
	side	1	6.000	6.000	0.150		5.400	
	AH west side	1	40.000	10.000	0.150		60.000	
	for road	1	30.000	5.000	0.150		22.500	
	rounded	1	4.100				4.100	
						Total Quantity	212.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	212.000 cum	
						Say 212.000 cum @ Rs 2963.59 / cum	**Rs 628281.08**	
2	16.80 Construction of dry lean cement concrete sub base over a prepared sub - grade with coarse and fine aggregate conforming to IS : 383, the size of coarse aggregate not exceeding 25 mm, aggregate cement ration not to exceed 15:1, aggregate gradation after blending to be as per specification, cement content not to be less than 150 Kg/ cum, optimum moisture content to be determined during trial length							

	construction, concrete strength not to be less than 10 Mpa at 7 days, mixed in a batching plant, transported to site, for all leads & lifts, laid with a mechanical paver, compacting with 8-10 tonne vibratory roller, finishing and curing etc. complete as per direction of Engineer-in-charge							
	Auction hall front	1	40.000	20.000	0.150		120.000	
	side	1	6.000	6.000	0.150		5.400	
	AH west side	1	40.000	10.000	0.150		60.000	
	for road	1	30.000	5.000	0.150		22.500	
	rounded	1	4.100				4.100	
						Total Quantity	212.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	212.000 cum	
						Say 212.000 cum @ Rs 4569.25 / cum	**Rs 968681.00**	
3	16.43.1 Providing and laying design mix cement concrete of M-30 grade, in roads/ taxi tracks/ runways, using cement content as per design mix, using coarse sand and graded stone aggregate of 40 mm nominal size in appropriate proportions as per approved & specified design criteria, providing dowel bars with sleeve/tie bars wherever required, laying at site, spreading and compacting mechanically by using needle and surface vibrators, levelling to required slope/ camber, finishing with required texture, including steel form work with sturdy M.S. channel sections, curing, making provision for contraction / expansion, construction & longitudinal joints (10 mm wide x 50 mm deep) by groove cutting machine, providing and filling joints with approved joint filler and sealants, complete all as per direction of Engineer-in-charge (Item of joint fillers, sealants, dowel bars with sleeve/tie bars to be paid separately). Note: Cement content considered in M-30 is @340 kg/cum. Excess/less cement used as per design mix is payable/ recoverable separately.Cement concrete prepared with batch mixing machine							
	Auction hall front	1	40.000	20.000	0.100		80.000	
	side	1	6.000	6.000	0.100		3.600	
	AH west side	1	40.000	10.000	0.100		40.000	
	for road	1	30.000	5.000	0.100		15.000	
	rounded	1	3.400				3.400	
						Total Quantity	142.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	142.000 cum	
						Say 142.000 cum @ Rs 10302.33 / cum	**Rs 1462930.86**	
4	5.22A.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Thermo - Mechanically Treated bars of grade Fe-500D or more							

	qty of CC	1	138.600			60.0	8316.000	@ 60kg/m3
	rounded	1	14.000				14.000	
						Total Quantity	8330.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	8330.000 kg	
						Say 8330.000 kg @ Rs 98.30 / kg	**Rs 818839.00**	
5	16.44 Extra for providing and mixing hardening compound of approved quality as per manufacturer's specification in cement concrete.							
	qty of cc 307.8*340=104652(2093 bags	1	2099.000			0.2	419.800	@200ml/50kg cement
	rounded	1	5.200				5.200	@200ml/50kg cement
						Total Quantity	425.000 Litre	
						Total Deducted Quantity	0.000 Litre	
						Net Total Quantity	425.000 Litre	
						Say 425.000 Litre @ Rs 59.86 / Litre	**Rs 25440.50**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
	5 Appendix E- Drain							
1	2.8.1 Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil							
	main drain from Auction hall to sump	1	50.000	1.300	1.000		65.000	
						Total Quantity	65.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	65.000 cum	
						Say 65.000 cum @ Rs 296.94 / cum	**Rs 19301.10**	
2	2.6.1 Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil							

	Pit of septic tank	1	8.200	4.000	2.450		80.360	
	soak pit 2m dia	1	3.140	1*1	2.100		6.594	
	round of	1	3.046				3.046	
						Total Quantity	90.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	90.000 cum	
						Say 90.000 cum @ Rs 214.03 / cum	**Rs 19262.70**	
3	4.1.8 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)							
	for drain	1	50.000	1.300	0.150		9.750	
	Pit of septic tank	1	8.200	4.000	0.200		6.560	
	round of	1	0.690				0.690	
						Total Quantity	17.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	17.000 cum	
						Say 17.000 cum @ Rs 6814.89 / cum	**Rs 115853.13**	
4	5.1.2 Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level:1:1:5:3 (1 cement 1.5 coarse sand :3 graded stone aggregate 20 mm nominal size							
	drain bottom slab	1	50.000	1.200	0.100		6.000	
	side wall	2	50.000	1.000	0.200		20.000	
	cover slad for drain 50/.5	100	1.000	0.500	0.150		7.500	
	cover slab septic tank	16	3.500	0.500	0.120		3.360	
	do beam	1	7.500	0.300	0.300		0.675	
	cover slab soak pit	1	3.140	1.100	0.120		0.415	
	round	1	0.050				0.050	
						Total Quantity	38.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	38.000 cum	
						Say 38.000 cum @ Rs 9085.14 / cum	**Rs 345235.32**	
5	5.9.5							

	Centering and shuttering including strutting, etc. and removal of form for:Lintels, beams, plinth beams, girders bressumers and cantilevers							
	side wall drain out	2	50.000	1.000			100.000	
	ide wall drain in	2	50.000	0.900			90.000	
						Total Quantity	190.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	190.000 sqm	
						Say 190.000 sqm @ Rs 649.82 / sqm	**Rs 123465.80**	
6	5.9.1 Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete							
	For cover slab drain 105 x 50 x 15 cm	100	3.100	0.150			46.500	
	For cover slab Effluent tank sides	16	8.000	0.120			15.360	
	beam	1	7.500	0.900			6.750	
	round	1	1.390				1.390	
						Total Quantity	70.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	70.000 sqm	
						Say 70.000 sqm @ Rs 335.31 / sqm	**Rs 23471.70**	
7	5.22A.1 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Mild steel and Medium Tensile steel bars							
	Qty of CC 38	1	38.000	90.000			3420.000	@90kg/m3
						Total Quantity	3420.000 kilogram	
						Total Deducted Quantity	0.000 kilogram	
						Net Total Quantity	3420.000 kilogram	
						Say 3420.000 kilogram @ Rs 96.68 / kilogram	**Rs 330645.60**	
8	50.6.1.1 Solid block masonry using pre cast solid blocks (factory made) of size 40x20x20cm or nearest available size confirming to IS 2185 part 1 of 1979 for foundation and plinth with thickness 20 cm and above in: CM 1:6 (1 cement : 6 coarse sand) etc complete							
	tank side wall	1	21.900	0.200	2.500		10.950	

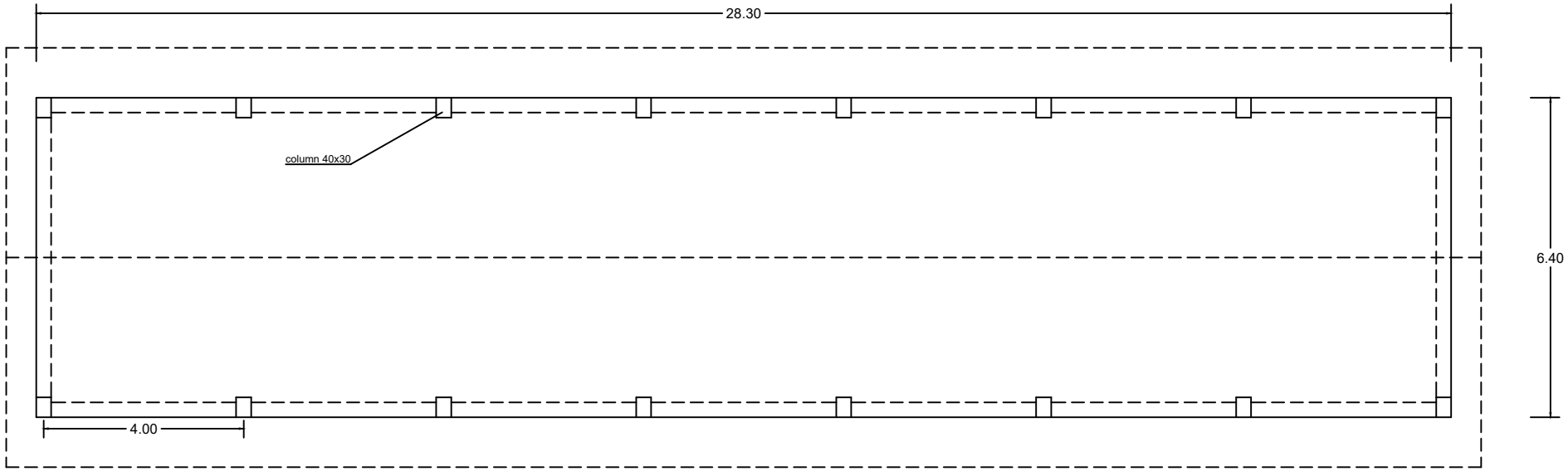
	soak pit 2.00m dia - bottom	1	6.280	0.200	0.300		0.377	
	roumd	1	0.673				0.673	
						Total Quantity	12.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	12.000 cum	
						Say 12.000 cum @ Rs 5908.32 / cum	**Rs 70899.84**	
9	6.23 Honey-comb brick work 10/11.4 cm thick with common burnt clay bricks of class designation 7.5 in super structure above plinth level upto floor V level with cement mortar 1:4 (1 cement : 4 coarse sand).							
	soak pit 2.00m dia - middle	1	6.280	1.300			8.165	
	rounded	1	0.835				0.835	
						Total Quantity	9.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	9.000 sqm	
						Say 9.000 sqm @ Rs 699.37 / sqm	**Rs 6294.33**	
10	13.7.2 12 mm cement plaster finished with a floating coat of neat cement of mix:1:4 (1 cement : 4 fine sand)							
	for Drain side wall - inside	1	50.000	2.600			130.000	
	Effluent tank side wall	2	31.600	2.500			158.000	
	cross wall	2	3.200	2.500			16.000	
	bottom	1	7.600	3.200			24.320	
	rounded	1	1.680				1.680	
						Total Quantity	330.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	330.000 sqm	
						Say 330.000 sqm @ Rs 386.36 / sqm	**Rs 127498.80**	

Sl No	Description	No	L	B	D	CF	Quantity	Remark
	6 Subsoil Investigation							
	Lump-Sum Total						**Rs 1000000.00**	

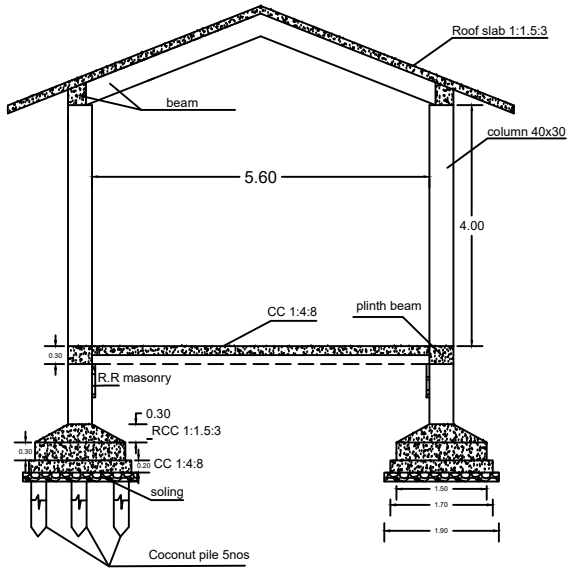
	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**7 Water supply and sanitary arrangement**							
	Lump-Sum Total						**Rs 1100000.00**	

	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**8 Electrification and yard lighting**							
Lump-Sum Total						**Rs 1000000.00**		
	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**9 Unforeseen expenses@2.5%**							
Lump-Sum Total						**Rs 4940000.00**		
	Provision for GST payments (in %) @						**18.0%**	
Amount reserved for GST payments						**35990955.36**		
Total						**235940707.36**		
Lumpsum for round off						**59292.64**		
TOTAL Rs 236000000.00								
Rounded Total Rs 23,60,00,000								
Rupees Twenty Three Crore Sixty Lakh Only								

(Cost Index Applied for this estimate is 35.59%)

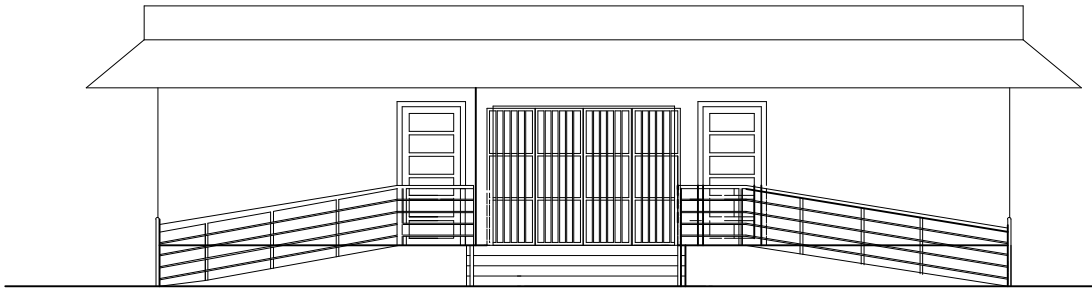


FLC Auction hall plan

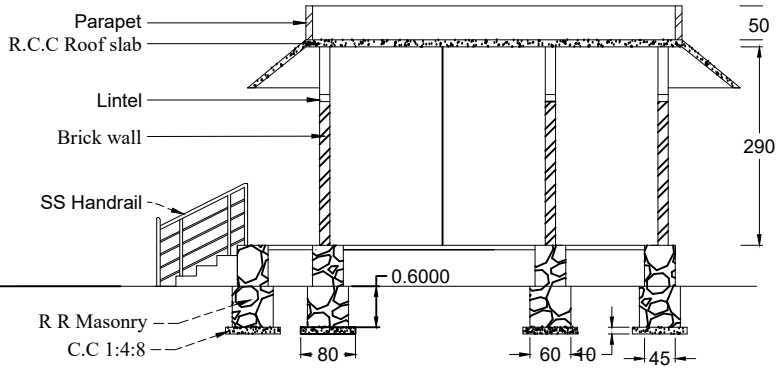


FLC Auction hall cross section

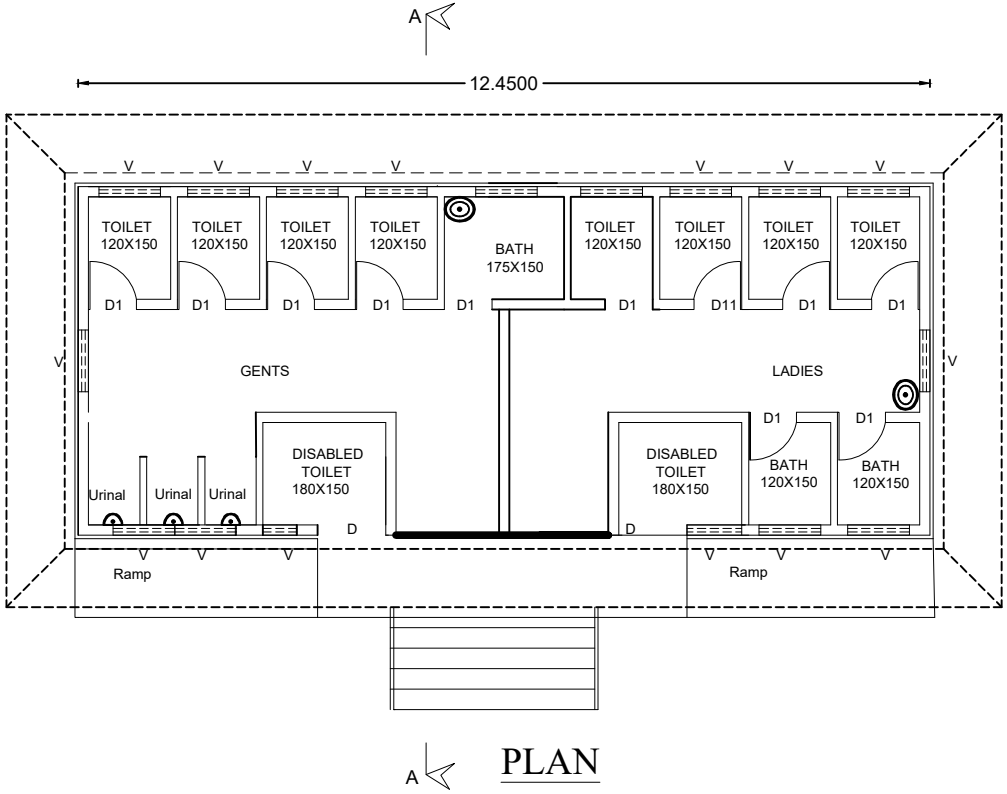
KSCADC **KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION**	**DEVELOPMENT OF VIPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT MALIPPURAM**				
DRAWING NO:		ASSISTANT ENGINEER:		**ASSISTANT ENGINEER:** SIGNATURE:	**ASSISTANT EXECUTIVE ENGINEER:** SIGNATURE:
DATE:		DRAWN:			
TYPE:	**DRAWING**	**REVISION**		**STRUCTURAL CONSULTANT:** DESIGNED & CHECKED BY	**CHIEF ENGINEER:** SIGNATURE:
TITLE:	FLC AUCTION HALL PLAN & SECTION	1.			
		2.			



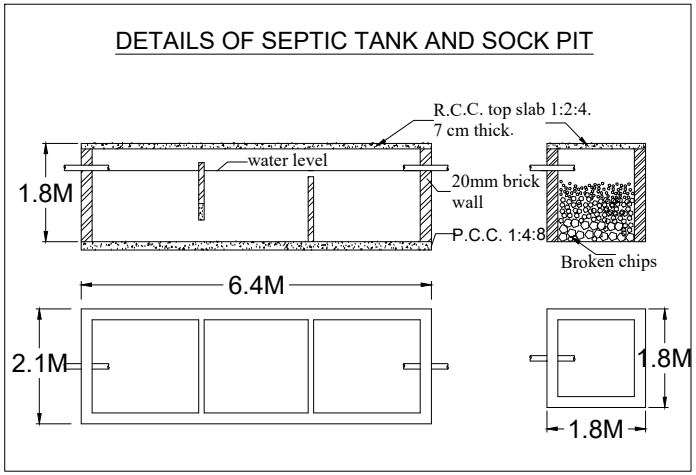
ELEVATION



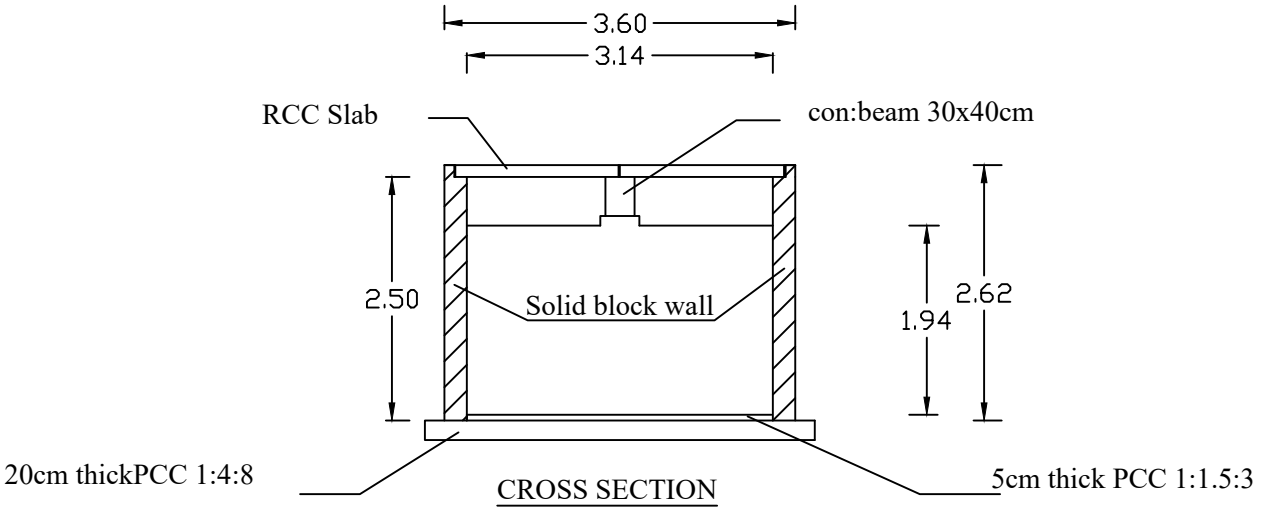
Section on A A



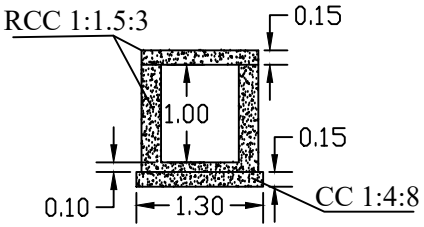
PLAN



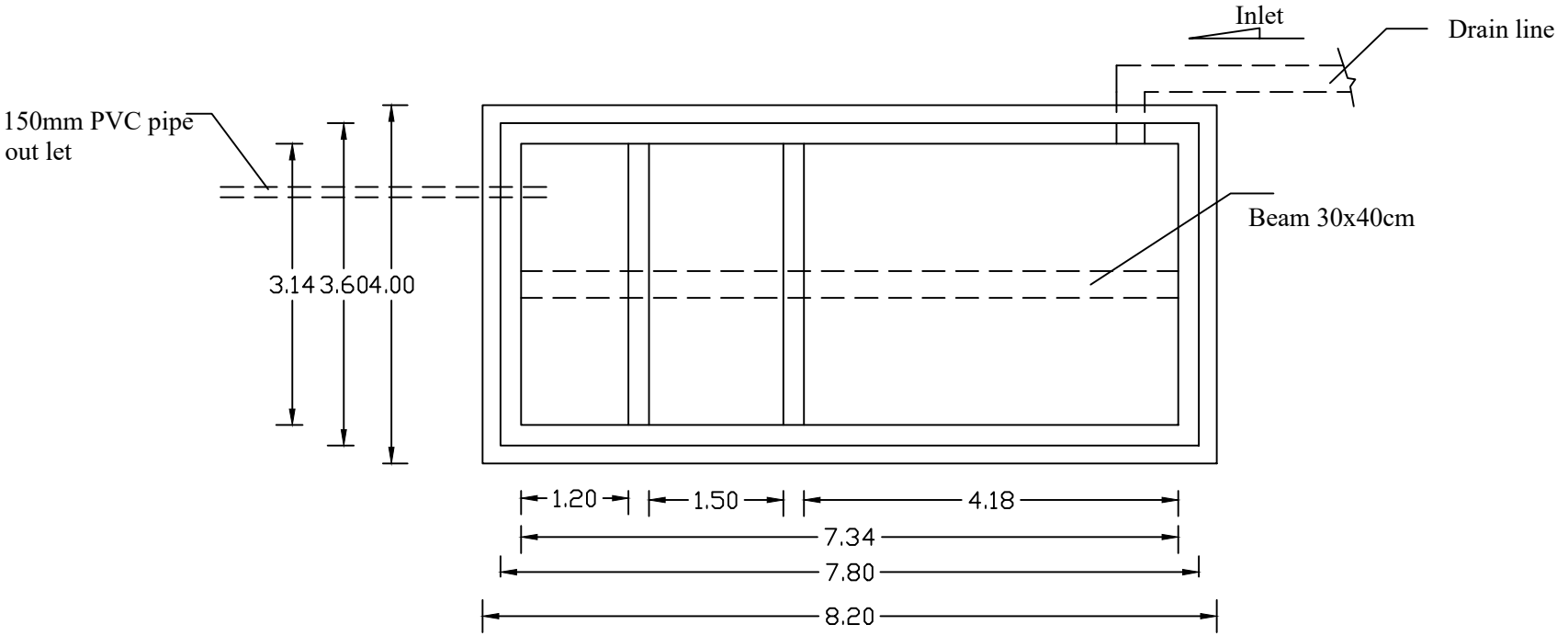
KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION	DEVELOPMENT OF VIPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT MALIPPURAM				
	DRAWING NO:		ASSISTANT ENGINEER:	ASSISTANT ENGINEER: SIGNATURE:	ASSISTANT EXECUTIVE ENGINEER: SIGNATURE:
	DATE:		DRAWN:		
	TYPE:	DRAWING	REVISION	STRUCTURAL CONSULTANT: DESIGNED & CHECKED BY	CHIEF ENGINEER: SIGNATURE:
	TITLE:	TOILET BLOCK	1. 2.		



CROSS SECTION



Drain Cross section



PLAN

KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION	DEVELOPMENT OF VIPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT MALIPPURAM				
	DRAWING NO:		ASSISTANT ENGINEER:	**ASSISTANT ENGINEER:** SIGNATURE:	**ASSISTANT EXECUTIVE ENGINEER:** SIGNATURE:
	DATE:		DRAWN:		
	TYPE:	**DRAWING**	**REVISION**	**STRUCTURAL CONSULTANT:** DESIGNED & CHECKED BY	**CHIEF ENGINEER:** SIGNATURE:
	TITLE:	FISH LANDING CENTRE DRAIN AND TREATMENT TANK	1. 2.		

ANNEXURE 3

Name of work : DEVELOPMENT OF VYPIN - MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION.-CONSTRUCTION OF FISH LANDING CENTRE AT VALIYATHAMPARAMBU

ESTIMATE REPORT

This estimate is prepared based on the study conducted by IIT Madras towards the shore protection of Vypin to Munambam stretch in Ernakulam district of Kerala. Based on the study conducted by IIT Madras, the estiamte is prepared for the construction of Fish landing center at Valiyathamparambu where in 2 groynes are proposed for coastal protection. In this estimate, extension of Northern Groyne and provision of a new southern groyne is proposed. A filter layer of 1kg to 10kg category stone, Core layer using 100 to 300 kg stones , Toe Mound using 500 to 800 kg stones , Armour layer using 1.5T to 2.5T stones proposed here. In addition to that 2T tetrapods at 1.96m Thick and 4T tetrapods at 2.50m Thick is provided for armour layer. Provision for Auction hall building of size 28.3m x 6.4m is included inthe estimate. For the auction hall, coconut piling of length 6m long is provided for foundation. RCC M20 provided for foundations, centering & shuttering, Reinforcement cement concrete work (M20) in walls isprovided for super structure. Necessary Steel reinforcement, plastering andpainting works are also included in the Auction hall. Provision for construction of a toilet block of size 12.5m x 5.1m is also included in the estimate. For the toilet block, RR masonry with cement mortar 1:6 is provided for the foundation.Solid block masonry of size 30x20x15cm and 40x20x10cm are provided for super structure. Ceramic tiling is provided in the floor and in the bathroom region. Necessary fittings are also provided for toilet block. Other provisions in the estimate include concrete parking area proposed near the the Auction hall. Provision for the construction of drain is also included in the estimate. Lump sum provisions for sub soil investigation, water supply and sanitary arrangement, Electrification and yard lighting are also included in the estimate. Lump sum provision for unforeseen expenses @2.5% are also included in the estimate. Total amount of estimate comes to Rupees 23.60 crore including 18% GST charges but excluding consultancy charges. The estimate is prepared in PRICE based on DSR 2018 and cost index is 35.59%. The provisions adopted in the estimate are adequate for proper completion of work. The estimate is prepared in PRICE based on DSR 2018 and cost index is 35.59%. The provisions adopted in the estimate are adequate for proper completion of work

INCLUDING COASTAL PROTECTION AND CONSTRACTION OF FISH LANDING CENTRE AT VALIYATHAMPARAMBU

COST ABSTRACT

1	***APPENDIX - A GROYNE***	***Rs.***	***17 75 05 385/-***
2	***APPENDIX B- CONSTRUCTION OF AUCTION HALL***	***Rs.***	***31 90 663/-***
3	***Appendix C- construction of Toilet block***	***Rs.***	***24 10 666/-***
4	***Appendix D- construction of Parking Area***	***Rs.***	***63 36 782/-***
5	***Appendix E - Construction of Drain***	***Rs.***	***11 44 187/-***
6	***Sub soil investigation***	***Rs.***	***15 00 000/-***
7	***Water supply and sanitary arrangement***	***Rs.***	***19 00 000/-***
8	***Electrification and yard lighting***	***Rs.***	***10 00 000/-***
9	***Unforeseen expenses @ 2.5%***	***Rs.***	***49 90 000/-***
10	***Sub Total***	***Rs.***	***19 99 77 684/-***
11	***GST @ 18%***	***Rs.***	***3 59 95 983/-***
12	***Total Amount including GST 18%***	***Rs.***	***23 59 73 667/-***
13	***Lumpsum for Round off***	***Rs.***	***26 333/-***
14	***Total Amount***	***Rs.***	***23 60 00 000/-***
15	***Consultancy @5%***	***Rs.***	***1 18 00 000/-***
16	***GST on consultancy @ 18%***	***Rs.***	***21 24 000/-***
17	***Round off***	***Rs.***	***76 000/-***
18	***Grand Total***	***Rs.***	***25 00 00 000/-***

Rupees Twenty Five Crore Only

DEVELOPMENT OF VYPIN - MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION.-CONSTRUCTION OF FISH LANDING CENTRE AT VALIYATHAMPARAMBU

General Abstract

(Dsor year: **2018**,Cost Index Applied for this estimate is **35.59**%)

Sl No	Heading Description	Amount
1	**APPENDIX A_ GROYNE**	177505384.77
2	**APPENDIX B CONSTRUCTION OF AUCTION HALL**	3190663.46
3	**Appendix C- construction of Toilet block**	2410665.96
4	**Appendix D- construction of Parking Area**	6336782.24
5	**Appendix E - Construction of Drain**	1144187.11
6	**Sub soil investigation**	1500000.00
7	**Water supply and sanitary arrangement**	1900000.00
8	**Electrification and yard lighting**	1000000.00
9	**Unforeseen charges @2.5%**	4990000.00
	Provision for GST payments (in %) @	**18.0%**
	Amount reserved for GST payments	**35995983.04**
	Total	**235973667.04**
	Lumpsum for round off	**26332.96**
		TOTAL Rs 236000000.00
		Rounded Total Rs 23,60,00,000
		Rupees Twenty Three Crore Sixty Lakh Only

(Cost Index Applied for this estimate is 35.59%)

DEVELOPMENT OF VYPIN - MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION.-CONSTRUCTION OF FISH LANDING CENTRE AT VALIYATHAMPARAMBU

Detailed Estimate

(Dsor year: **2018**,Cost Index Applied for this estimate is **35.59**%)

Sl No	Description	No	L	B	D	CF	Quantity	Remark
	1 APPENDIX A_ GROYNE							
1	od209388/2023_2024 Moulding and supplying cement concrete 1.6m3 (4T) tetrapod with graded aggregate of 40% 75mm to 40 mm, 30% 40 to 20mm, 30% 20 to 5mm using 380 kg cement /m3 pf cpmcrete as per approved mix design of mix proportion 0.5:,1.46:3.22 by weight of water cement, fine aggregate, course aggregate (specific gravity of fine aggregate and course aggregateshould not be less than 2.73 and 2.5 respectively) and the cement shall be 43 grade or higher) minimum cube strength requirement (i) @ 7 day - 20N/mm2 (ii) @ 28 day - 30N/mm2 and minimum density of concrete 2.5 g/cc. including hire and operational charge of tools and plants moulding and rehandling and stacking charge etc complete according to specification and instructions of Engineer							
	ARMOUR LAYER, 4T tetrapods at 2.50m Thick	3015					3015.000	
	Total Quantity						3015.000 each	
	Total Deducted Quantity						0.000 each	
	Net Total Quantity						3015.000 each	
	Say 3015.000 each @ Rs 15999.39 / each						**Rs 48238160.85**	
2	od209390/2023_2024 Conveying 1.6m3 (4T) tetrapods from stacking and placing in two layer according to specification and forming the armour layer of break water to lines and levels at depth of water 8m and above including hire and operational charges of tools and plants etc complete							
	ARMOUR LAYER, 4T tetrapods at 2.50m Thick	3015					3015.000	
	Total Quantity						3015.000 each	
	Total Deducted Quantity						0.000 each	
	Net Total Quantity						3015.000 each	
	Say 3015.000 each @ Rs 2042.97 / each						**Rs 6159554.55**	
3	65.103 Moulding and supplying 0.8 cum(2T) tetrapod with graded aggregate of 40% 75mm to 40mm, 30% 40mm to 20mm and 30% 20mm to 6mm using 380kg cement/ m3 of concrete as per approved mix design of mix proportion 0.5:1:1. 46:3.22 by weight of water cement, fine aggregate, coarse aggregate (specific gravity of fine aggregate and coarse aggregate should not be less than 2.73 and 2.5 respectively) and the cement shall be 43 grade or higher) minimum cube strength requirement (i) @7 day - 20 N/mm2 (ii) @ 28							

	day - 30 N/mm2 and minimum density of concrete 2.5 g/cc including hire and operational charges of tools and plants, mould, curing, rehandling and stacking charges etc., complete as per the instruction of departmental officers at site .							
	ARMOUR LAYER, 2T tetrapods at 1.96m Thick	2705					2705.000	
						Total Quantity	2705.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	2705.000 each	
						Say 2705.000 each @ Rs 7596.47 / each	**Rs 20548451.35**	
4	65.104 Conveying 0.8cum (2T) tetrapod from stacking yard and placing in position in two layers according to specification and forming the armour layer of breakwater to lines and levels over the secondary armour layer including hire and operational charges of tools and plants etc., complete as per the direction of the departmental officers at site							
	ARMOUR LAYER, 2T tetrapods at 1.96m Thick	2075					2075.000	
						Total Quantity	2075.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	2075.000 each	
						Say 2075.000 each @ Rs 912.92 / each	**Rs 1894309.00**	
5	2.6.1 Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil							
	From Chainage 0 to 40m	2	40.000	35.000	2.000		5600.000	
						Total Quantity	5600.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	5600.000 cum	
						Say 5600.000 cum @ Rs 214.03 / cum	**Rs 1198568.00**	
6	od209394/2023_2024 Supplying and laying Geotextile 120 gram per sqm membrane (best quality) including providing necessary overlaps, all cost, conveyance, labour charges etc complete as per the instruction of departmental officers at site.							
	Geotextile Layer							

	Northern Groyne 210m Chainage 0 to210	1	210.000	40.000			8400.000	
	Southern Groyne 170m							
	Chainage 0 to 170m	1	170.000	40.000			6800.000	
						Total Quantity	15200.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	15200.000 sqm	
						Say 15200.000 sqm @ Rs 83.20 / sqm	**Rs 1264640.00**	
7	od209395/2023_2024 [Based on 65.32]Supplying blasted rock from approved quarry to sorting site and sorting the stones into 1.5T to 2.5T(70% of stones > 2.0T) category stones of approved quality having specific gravity ranges from 2.65 to 2.8 for forming the primary armour and berm of rubble mount breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and the measurements of catagorised stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater and forming the primary armour of the breakwater to the lines and levels as per approved drawings with tolerance of +/- 20 cm in final levels including all cost and labour charges, hire and operational charges of mobile crane and excavator, rehandling, placing and packing and using mobile crane, inspecting the profile once in a week and cost of spalls/quarry muck and hire of machineries for forming the roadway for movement of lorries/tippers/cranes etc including all incidental charges etc complete as per the direction of departmental officers at site Ernakulam District								
	Armour layer using 1.5T to 2.5T stones (Assuming 1/3 void and sp.gravity 2.7)							
	Northern Groyne 210m Chainage 0 to210	1	5934.000				5934.000	
	Southern Groyne 170m							
	Chainage 0 to 170m	1	4803.720				4803.720	
						Total Quantity	10737.720 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	10737.720 tonne	
						Say 10737.720 tonne @ Rs 1781.12 / tonne	**Rs 19125167.85**	
8	od209396/2023_2024 Supplying blasted rock from approved quarry to sorting site and sorting the stones into 500kg to 800kg category stones of approved quality having specific gravity ranges from 2.65 to 2.8 for forming the primary armour and berm of rubble mount breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and the measurements of catagorised stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and							

	conveyed to the approved alignment of the breakwater and forming the primary armour of the breakwater to the lines and levels as per approved drawings with tolerance of +/- 20 cm in final levels including all cost and labour charges, hire and operational charges of mobile crane and excavator, rehandling, placing and packing and using mobile crane, inspecting the profile once in a week and cost of spalls/quarry muck and hire of machineries for forming the roadway for movement of lorries/tippers/cranes etc including all incidental charges etc complete as per the direction of departmental officers at site Ernakulam District							
	Toe Mound using 500 to 800 kg stones (Assuming 1/3 void and sp.gravity 2.7)							
	Northern Groyne 210m Chainage 0 to210m	1	8849.300		1.050		9291.765	5% sinkage added
	Head	1	737.650		1.050		774.533	5% sinkage added
	Southern Groyne 170m							
	Chainage 0 to 170m	1	7163.710		1.050		7521.896	
	Head	1	630.360		1.050		661.878	
						Total Quantity	18250.072 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	18250.072 tonne	
						Say 18250.072 tonne @ Rs 1781.12 / tonne	**Rs 32505568.24**	
9	od209459/2023_2024 [Based on 65.30]Supplying granite blasted rock from approved quarry to sorting site by lorry/ tipper, and sorting the stones into 100kg to 300kg category stones of approved quality having specific gravity ranging from 2.65 to 2.8 for forming the core of rubble mound breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and measurements of categorized stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater and rehandling and forming the core of the break water to the lines and levels as per the approved drawings and inspecting the profile once in a week with tolerance of +/- 20cm in final levels including all cost and labour charges, hire and operational charges of light crane and cost of spalls/ quarry muck and labour for forming the roadway for movement of lorries/ tippers / cranes etc including all incidental charges etc complete as per the direction of departmental officers at site Ernakulam District							
	Core layer using 100 to 300 kg stones (Assuming 1/3 void and sp.gravity 2.7)							
	Northern Groyne 210m Chainage 0 to210	1	10617.360		1.100		11679.097	10% sinkage added

	Head	1	387.010		1.100		425.711	10% sinkage added
	Southern Groyne 170m							
	Chainage 0 to 170m	1	8595.000		1.100		9454.500	
	Head	1	499.380		1.100		549.318	
						Total Quantity	22108.626 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	22108.626 tonne	
						Say 22108.626 tonne @ Rs 1610.75 / tonne	**Rs 35611469.33**	
10	od209460/2023_2024 Supplying granite quarry run from approved quarry to sorting site by lorry/ tipper, and sorting the stones into 1 kg to 10 kg category stones of approved quality with specific gravity ranging from 2.65 to 2.8 for forming the filter layer of breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and the measurements of categorized stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater including conveyance from sorting platform and dumping stones using tippler (3.5x2.5 sqm size) or any suitable methods installed at site on a moving crane having a capaciaty of not less than 20T and placing the stones at sea bed in uniform layer of design thickness for forming filter layer of breakwater as per the approved drawing and design and inspecting the profile once in a week including hire and operational charges of T & P, tippler, crane and all incidental charges etc. complete as per the direction of departmental officers at site. Eranakulam District								
	Filter layer using 1 to 10 kg stones (Assuming 1/3 void and sp.gravity 2.7)							
	Northern Groyne 210m Chainage 0 to210	1	3341.270				3341.270	
	Head	1	305.420				305.420	
	Southern Groyne 170m							
	Chainage 0 to 170m	1	2704.830				2704.830	
	Head	1	330.040				330.040	
						Total Quantity	6681.560 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	6681.560 tonne	
						Say 6681.560 tonne @ Rs 1640.26 / tonne	**Rs 10959495.61**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
2 APPENDIX B CONSTRUCTION OF AUCTION HALL								

1	2.8.1 Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil							
	column footing	16	2.100	2.100	1.900		134.064	
	below out side plinth beam	2*7	3.700	0.450	0.600		13.986	
	cross beam	2	5.800	0.450	0.600		3.132	
	rounded	1	3.818				3.818	
						Total Quantity	155.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	155.000 cum	
						Say 155.000 cum @ Rs 296.94 / cum	**Rs 46025.70**	
2	od209389/2023_2024 Supplying and stacking good quality coconut piles							
	For pile 16 x5 Nos =80 Nos	80	6.000				480.000	
						Total Quantity	480.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	480.000 metre	
						Say 480.000 metre @ Rs 107.64 / metre	**Rs 51667.20**	
3	od209391/2023_2024 Coconut Pile- Driving down coconut pile to lines and levels through soft to medium clay soil strata including all hire charges and labour for fixing, staging platform and all other appliances necessary for pile driving down after pointing the bottom end. Details of one post of 6m long 15 numbers per day 6x15=90m.							
	For coconut pile	80	6.000				480.000	
						Total Quantity	480.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	480.000 metre	
						Say 480.000 metre @ Rs 216.92 / metre	**Rs 104121.60**	
4	od209392/2023_2024 Cutting and removing the excess length of wooden piles to lines and levels and removing the cut end of piles and stacking within 150m							
	excess length of pile	16	1.000				16.000	
						Total Quantity	16.000 metre	

						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	16.000 metre	
						Say 16.000 metre @ Rs 154.21 / metre	**Rs 2467.36**	
5	2.18.1 Close timbering over areas including strutting, shoring and packing cavities (wherever required) etc. complete (Measurements to be taken of the face area timbered):Depth not exceeding 1.5 m							
	column excavation side	16*4	2.000	1.200			153.600	
	rounded	1	1.400				1.400	
						Total Quantity	155.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	155.000 sqm	
						Say 155.000 sqm @ Rs 136.88 / sqm	**Rs 21216.40**	
6	od209393/2023_2024 Providing and laying filter media with granular crushed aggregates as per specification to a thickness of not less than 600 mm with smaller size towards the soil and bigger size towards the wall and providing over the entire surface behind abutment, wing wall, return wall to the full height, compacted to firm condition complete as per drawing and technical specification Clause 1204.3.8 of MoRD ncluding cost of all materials ,conveyance,labour charges, etc. complete 							
	bottom of column footing	16	1.900	1.900	0.300		17.328	
	rounding	1	0.672				0.672	
						Total Quantity	18.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	18.000 cum	
						Say 18.000 cum @ Rs 1679.73 / cum	**Rs 30235.14**	
7	50.2.3.1 Pumping or Bailing out water and removing slush etc by using pump set including cost of labour, oil hire charges of pumpset, etc complete							
	For earth work 16 column	2	8.000				16.000	
	For coconut pilling	1	8.000				8.000	
	cc for footing & soling	1	8.000				8.000	
	reinforcement work,shuttering@ concrete for footing	4	8.000				32.000	

						Total Quantity	64.000 hour	
						Total Deducted Quantity	0.000 hour	
						Net Total Quantity	64.000 hour	
						Say 64.000 hour @ Rs 284.60 / hour	**Rs 18214.40**	
8	4.1.8 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)							
	column C1 to C16	16	1.700	1.700	0.200		9.248	
	below plinth beam	2*7	3.700	0.450	0.100		2.331	
	cross beam	8	5.600	0.450	0.100		2.016	
	AH floor	7	5.700	3.700	0.150		22.145	
	rounded	1	0.260				0.260	
						Total Quantity	36.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	36.000 cum	
						Say 36.000 cum @ Rs 6814.89 / cum	**Rs 245336.04**	
9	5.1.2 Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level:1:1:5:3 (1 cement 1.5 coarse sand :3 graded stone aggregate 20 mm nominal size							
	column footing C1 to C16	16	1.500	1.500	0.300		10.800	
		16	((1.5*1.5)+(.4*.3))/2		0.300		5.688	
	column up to plinth	16	0.300	0.400	1.000		1.920	
	rounded	1	0.592				0.592	
						Total Quantity	19.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	19.000 cum	
						Say 19.000 cum @ Rs 9085.14 / cum	**Rs 172617.66**	
10	5.2.2 Reinforced cement concrete work in walls (any thickness), including attached pilasters, buttresses, plinth and string courses, fillets, columns, pillars, piers, abutments, posts and struts etc. up tot floor five level excluding cost of centering, shuttering, finishing and reinforcement :1:1.5:3(1 cement : 1.5 coarse sand : 3 graded stone aggregate 20 mm nominal size)							

	plinth beam	2	28.300	0.300	0.300		5.094	
	-do- cross	8	5.800	0.300	0.400		5.569	
	column up to beam C1 to C16	16	0.400	0.300	4.000		7.680	
	roof beam long	2	28.300	0.300	0.350		5.943	
	inglind beam	2*8	3.200	0.300	0.350		5.376	
	roof slab	2	29.500	4.5500	0.120		32.214	
	rounded	1	0.124				0.124	
						Total Quantity	62.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	62.000 cum	
						Say 62.000 cum @ Rs 10954.04 / cum	**Rs 679150.48**	
11	5.9.1 Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete							
	Column base	16*4	1.500	0.300			28.800	
	Column up to plinth	16*2	0.400		1.100		14.081	
		16*2	0.300		1.100		10.560	
	rounded	1	0.559				0.559	
						Total Quantity	54.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	54.000 sqm	
						Say 54.000 sqm @ Rs 335.31 / sqm	**Rs 18106.74**	
12	5.9.3 Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform							
	roof slab bottom	2*7	3.700	3.200			165.761	
	side projection	2*2	4.500	0.600			10.800	
	slab projection	2	29.500	1.000			59.000	
	slab projection side	2	29.500	0.120			7.080	
	end side	2*2	4.500	0.120			2.160	
	rounded	1	5.199				5.199	
						Total Quantity	250.000 sqm	
						Total Deducted Quantity	0.000 sqm	

						Net Total Quantity	250.000 sqm	
						Say 250.000 sqm @ Rs 815.78 / sqm	**Rs 203945.00**	
13	5.9.5 Centering and shuttering including strutting, etc. and removal of form for:Lintels, beams, plinth beams, girders bressumers and cantilevers							
	plinth beam out side	2	28.300	0.300			16.980	
	plinth beam in side	2*7	3.700	0.300			15.541	
	cross beam	8*2	5.800	0.400			37.120	
	roof beam out side	2	28.300	0.300			16.980	
	roof beam in side	2*7	3.700	0.400			20.721	
	roof beam bottom	2*7	3.700	0.300			15.541	
	inglind beam side	2*8*2	3.200	0.350			35.840	
	inglind beam bottom	2*8	3.200	0.300			15.360	
	rounded	1	0.917				0.917	
						Total Quantity	175.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	175.000 sqm	
						Say 175.000 sqm @ Rs 649.82 / sqm	**Rs 113718.50**	
14	5.9.6 Centering and shuttering including strutting, etc. and removal of form for:Columns, Pillars, Piers, Abutments, Posts and Struts							
	column C1 to C16	16*2	0.400	4.000			51.200	
		16*2	0.300	4.000			38.400	
	rounded	1	0.400				0.400	
						Total Quantity	90.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	90.000 sqm	
						Say 90.000 sqm @ Rs 863.64 / sqm	**Rs 77727.60**	
15	5.22.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more							
	For column footing	1	16.580			100.0	1658.000	@100kg/ m3
	column up to plinth	1	1.800			120.0	216.000	@120kg/ m3

	rounded	1	6.000				6.000	@120kg/ m3
						Total Quantity	1880.000 kilogram	
						Total Deducted Quantity	0.000 kilogram	
						Net Total Quantity	1880.000 kilogram	
						Say 1880.000 kilogram @ Rs 98.30 / kilogram	**Rs 184804.00**	
16	5.22A.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Thermo - Mechanically Treated bars of grade Fe-500D or more							
	qty vide item No 10 @ 100kg/m3	1	61.876			100.0	6187.600	@100 kg /m3
	rounded	1	12.400				12.400	@100 kg /m3
						Total Quantity	6200.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	6200.000 kg	
						Say 6200.000 kg @ Rs 98.30 / kg	**Rs 609460.00**	
17	7.1.1 Random rubble masonry with hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 (1 cement : 6 coarse sand : 12 graded stone aggregate 20 mm nominal size) up to plinth level with:Cement mortar 1:6 (1 cement : 6 coarse sand)							
	below out side plinth beam	2*7	3.700	0.450	0.600		13.986	
	below cross beam	2	5.800	0.450	0.600		3.132	
	rounded	1	0.882				0.882	
						Total Quantity	18.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	18.000 cum	
						Say 18.000 cum @ Rs 7204.78 / cum	**Rs 129686.04**	
18	2.25 Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.							
	in betwen plinth beams	7	5.700	3.700	0.300		44.290	
	Back filling footing trenches	16	3.000				48.000	

	rounded	1	2.710				2.710	
						Total Quantity	95.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	95.000 cum	
						Say 95.000 cum @ Rs 258.57 / cum	**Rs 24564.15**	
19	13.7.1 12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)							
	For the roof slabs. Top	2	29.500	4.5500			268.450	
	side	2	29.500	0.130			7.670	
	end side	2	9.050	0.130			2.353	
	rounded	1	1.527				1.527	
						Total Quantity	280.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	280.000 sqm	
						Say 280.000 sqm @ Rs 401.21 / sqm	**Rs 112338.80**	
20	13.16.1 6 mm cement plaster of mix:1:3 (1 cement : 3 fine sand)							
	For cross beams side	2*8	6.200	0.350			34.720	
	bottom	8	6.200	0.300			14.880	
	long beam in side	2*7	3.700	0.400			20.721	
	long beam out side	2	28.300	0.300			16.980	
	bottom	2*7	3.700	0.300			15.541	
	slab bottom	2*7	3.700	3.200			165.761	
	roof projection end	2*2	4.500	0.600			10.800	
	out side beam projection side	2	29.500	1.050			61.950	
	column	16	4.000	1.400			89.600	
		1	4.047	1.000			4.047	
						Total Quantity	435.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	435.000 sqm	
						Say 435.000 sqm @ Rs 267.59 / sqm	**Rs 116401.65**	
21	13.4.1							

	12 mm cement plaster of mix:1:4 (1 cement : 4 coarse sand)							
	Auction hall floor	1	28.300	6.400			181.120	
	Rounded	1	3.880				3.880	
						Total Quantity	185.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	185.000 sqm	
						Say 185.000 sqm @ Rs 325.01 / sqm	**Rs 60126.85**	
22	13.43.1 Applying one coat of water thinnable cement primer of approved brand and manufacture on wall surface:Water thinnable cement primer							
	roof beam side & bottom	8	6.200	1.000			49.600	
	long beam out side	2	28.300	0.400			22.640	
	inside	2*7	3.700	0.400			20.721	
	bottom	2*7	3.700	0.300			15.541	
	slab bottom	2*7	3.700	3.200			165.761	
	roff projection end	2*2	4.500	0.600			10.800	
	roff projection side	2	29.500	1.050			61.950	
	column	16	4.000	1.400			89.600	
	side end	2	9.050	0.130			2.353	
	projection side	2	29.500	0.130			7.670	
	top of roof slab	2	29.500	4.550			268.450	
	rounded	1	4.914				4.914	
						Total Quantity	720.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	720.000 sqm	
						Say 720.000 sqm @ Rs 70.64 / sqm	**Rs 50860.80**	
23	13.44.1 Finishing walls with water proofing cement paint of required shade:New work (Two or more coats applied @ 3.84 kg/10 sqm)							
	slab bottom	2*7	3.700	3.200			165.761	
	roof projection end	2*2	4.500	0.600			10.800	
	roof projection side	2	29.500	1.050			61.950	
		1	1.489				1.489	

						Total Quantity	240.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	240.000 sqm	
						Say 240.000 sqm @ Rs 107.39 / sqm	**Rs 25773.60**	
24	13.46.1 Finishing walls with Acrylic Smooth exterior paint of required shade:New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm)							
	roof beam allround	8	6.200	1.000			49.600	
	long beam out side	2	28.300	0.300			16.980	
	long beam in side	2*7	3.700	0.400			20.721	
	bottom	2*7	3.700	0.300			15.541	
	column C1 to C16	16	4.000	1.400			89.600	
	top of roof slab	2	29.500	4.550			268.450	
	side	2	29.500	0.130			7.670	
	side end	2	9.050	0.130			2.353	
		1	4.085				4.085	
						Total Quantity	475.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	475.000 sqm	
						Say 475.000 sqm @ Rs 193.89 / sqm	**Rs 92097.75**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
3 Appendix C- construction of Toilet block								
1	2.8.1 Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil							
	toilet block foundation all round	1	35.500	0.800	0.750		21.300	
	crosswall long	2	11.500	0.800	0.750		13.800	
	cross	1	6.050	0.800	0.750		3.630	
		1	3.150	0.800	0.750		1.891	
	bath room	1	4.800	0.800	0.750		2.880	
	ramp	2	4.500	0.800	0.750		5.400	
	step	1	3.500	1.200	0.600		2.520	

		1	3.000	0.800	0.750		1.801	
	setitank	1	6.700	2.400	2.000		32.160	
	sock pit	1	1.800	1.800	1.500		4.860	
		1	4.758				4.758	
						Total Quantity	95.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	95.000 cum	
						Say 95.000 cum @ Rs 296.94 / cum	**Rs 28209.30**	
2	2.26.1 Extra for every additional lift 1.5 m or part there of in excavation / banking excavated or stacked materials.All kinds of soil							
	tank	1	6.700	2.400	0.500		8.040	
	rounded	1	1.960				1.960	
						Total Quantity	10.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	10.000 cum	
						Say 10.000 cum @ Rs 106.37 / cum	**Rs 1063.70**	
3	4.1.8 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)							
	toilet block foundation all round	1	35.500	0.800	0.150		4.260	
	crosswall long	2	11.500	0.800	0.150		2.761	
	cross	1	6.050	0.800	0.150		0.726	
		1	3.150	0.800	0.150		0.378	
	bath room	1	4.800	0.800	0.150		0.576	
	ramp	2	4.500	0.800	0.150		1.080	
	step	1	3.500	1.200	0.150		0.630	
		1	3.000	0.800	0.150		0.361	
	setitank	1	6.700	2.400	0.200		3.216	
	floor room	1	12.150	4.800	0.100		5.833	
	ramp& varandha	1	13.500	1.200	0.100		1.620	
	rounded	1	0.559				0.559	
						Total Quantity	22.000 cum	

						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	22.000 cum	
						Say 22.000 cum @ Rs 6814.89 / cum	**Rs 149927.58**	
4	7.1.1 Random rubble masonry with hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 (1 cement : 6 coarse sand : 12 graded stone aggregate 20 mm nominal size) up to plinth level with:Cement mortar 1:6 (1 cement : 6 coarse sand)							
	toilet block foundation all round	1	35.500	0.600	0.600		12.780	
	crosswall long	2	11.500	0.600	0.600		8.280	
	cross	1	6.050	0.600	0.600		2.178	
		1	3.150	0.600	0.600		1.134	
	bath room	1	4.800	0.600	0.600		1.728	
	ramp	2	4.500	0.600	0.600		3.240	
	step	1	3.500	1.200	0.450		1.891	
		1	3.000	0.600	0.600		1.080	
	toilet block basement all round	1	35.500	0.450	0.450		7.189	
	crosswall long	2	11.500	0.450	0.450		4.658	
	cross	1	6.050	0.450	0.450		1.226	
		1	3.150	0.450	0.450		0.638	
	bath room	1	4.800	0.450	0.450		0.973	
	ramp	2	3.150	0.450	0.300		0.851	
		1	3.000	0.450	0.450		0.608	
	partition	10	1.500	0.450	0.450		3.038	
	rounded	1	0.508				0.508	
						Total Quantity	52.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	52.000 cum	
						Say 52.000 cum @ Rs 7204.78 / cum	**Rs 374648.56**	
5	2.25 Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.							
	for foundation	1	11.550	3.900	0.600		27.027	

	varandha	1	7.000	0.750	0.600		3.150	
	rounded	1	4.823				4.823	
						Total Quantity	35.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	35.000 cum	
						Say 35.000 cum @ Rs 258.57 / cum	**Rs 9049.95**	
6	5.2.2 Reinforced cement concrete work in walls (any thickness), including attached pilasters, buttresses, plinth and string courses, fillets, columns, pillars, piers, abutments, posts and struts etc. up tot floor five level excluding cost of centering, shuttering, finishing and reinforcement :1:1.5:3(1 cement : 1.5 coarse sand : 3 graded stone aggregate 20 mm nominal size)							
	basement allround	1	35.500	0.450	0.100		1.598	
	cross	1	11.500	0.450	0.100		0.518	
		1	6.050	0.450	0.100		0.273	
		1	3.150	0.450	0.100		0.142	
	bath	1	4.800	0.450	0.100		0.217	
	ramp	1	3.150	0.450	0.100		0.142	
		1	3.000	0.450	0.100		0.135	
	partition	10	1.500	0.450	0.100		0.675	
	lintel	1	76.000	0.150	0.150		1.710	
	roof slab	1	12.750	5.800	0.120		8.874	
	slop	1	39.450	1.000	0.120		4.734	
	tank bottom	1	6.000	2.100	0.150		1.891	
	beam	1	2.100	0.200	0.200		0.085	
	cover slab	1	6.000	2.100	0.120		1.512	
		1	1.800	1.800	0.120		0.389	
	rounded	1	0.105				0.105	
						Total Quantity	23.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	23.000 cum	
						Say 23.000 cum @ Rs 10954.04 / cum	**Rs 251942.92**	
7	5.9.3 Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform							
	basement top	2	35.500	0.100			7.101	

	cross	2	11.500	0.100			2.301	
		2	6.050	0.100			1.210	
		2	3.150	0.100			0.630	
	bath	2	4.800	0.100			0.960	
	ramp	2	6.150	0.100			1.231	
	partition	10*2	1.500	0.100			3.001	
	lintel	2	76.000	0.150			22.800	
	roof slab	1	12.750	5.800			73.950	
	slop	1	39.450	1.000			39.450	
	tank bottom	4	10.200	0.150			6.120	
	beam	1	2.100	0.600			1.260	
	cover slab	12	5.100	0.120			7.344	
		3	4.800	0.120			1.728	
		1	0.914				0.914	
						Total Quantity	170.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	170.000 sqm	
						Say 170.000 sqm @ Rs 815.78 / sqm	**Rs 138682.60**	
8	5.22A.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Thermo - Mechanically Treated bars of grade Fe-500D or more							
	qty of cc	1	22.895			100.0	2289.500	@100kg/ m3
	rounded	1	10.500				10.500	@100kg/ m3
						Total Quantity	2300.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	2300.000 kg	
						Say 2300.000 kg @ Rs 98.30 / kg	**Rs 226090.00**	
9	50.6.2.2 Solid masonry using pre cast solid blocks (factory made) of size 30x20x15cm or nearest available size confirming to IS 2185 part I of 1979 for super structure up to floor two level with thickness 15cm in : CM 1:6 (1 cement : 6 coarse sand) etc complete							
	wall all round	1	34.500	2.800	0.150		14.490	
	cross wal	1	12.150	2.800	0.150		5.103	

	centre cross	1	3.150	2.800	0.150		1.323	
		1	6.050	2.800	0.150		2.541	
	bath	1	4.800	2.800	0.150		2.016	
	septitank	1	16.200	1.800	0.200		5.833	
	step	1	3.000	0.600	0.450		0.810	
	rounded	1	0.593				0.593	
	shutter	1	3.000	2.400	0.150		-1.079	
	door D DA toilet	2	1.000	2.100	0.150		-0.630	
						Total Quantity	32.709 cum	
						Total Deducted Quantity	-1.709 cum	
						Net Total Quantity	31.000 cum	
						Say 31.000 cum @ Rs 6984.85 / cum	**Rs 216530.35**	
10	50.6.3.2 Solid block masonry using pre cast solid blocks (Factory made) of size 40x20x10 cm or nearest available size confirming to IS 2185 part I of 1979 for super structure up to floor two level for 10 cm thick wall in : CM 1:6 (1 cement : 6 coarse sand) including cost of scaffolding complete							
	toilet partition	10	1.500	2.800	0.100		4.200	
	urinal partition	2	1.000	1.400	0.100		0.280	
	parapet	1	37.100	0.600	0.100		2.227	
	seititank partition	2	1.700	1.000	0.100		0.340	
	sock pit	4	1.700	1.200	0.100		0.817	
	rounded	1	0.459				0.459	
	door D1	9	0.700	2.100	0.100		-1.323	
						Total Quantity	8.323 cum	
						Total Deducted Quantity	-1.323 cum	
						Net Total Quantity	7.000 cum	
						Say 7.000 cum @ Rs 7823.61 / cum	**Rs 54765.27**	
11	13.1.1 12 mm cement plaster of mix:1:4 (1 cement : 4 fine sand)							
	out side wall	1	35.300	2.800			98.840	
	Parapet	1	37.100	1.400			51.940	
	toilet inside	10	5.400	2.800			151.200	
	DA toilet	2	6.600	2.800			36.960	
	out side	2	4.800	2.800			26.880	

	bath	1	6.500	2.800			18.200	
	partition	2	3.150	2.800			17.640	
		1	5.300	2.800			14.840	
		1	5.500	2.800			15.400	
		1	3.200	2.800			8.960	
		1	4.850	2.800			13.580	
		1	2.500	2.800			7.000	
	urinal partition	2	2.100	1.500			6.301	
	under side slab	1	12.750	5.800			73.950	
		1	39.450	1.000			39.450	
	rounded	1	5.927				5.927	
	door D	2	1.000	2.100			-4.200	
	toilet door D1	11	0.700	2.100			-16.169	
	ventilator	15	0.600	0.500			-4.500	
	shutter	1	3.000	2.400			-7.199	
						Total Quantity	587.068 sqm	
						Total Deducted Quantity	-32.068 sqm	
						Net Total Quantity	555.000 sqm	
						Say 555.000 sqm @ Rs 314.09 / sqm	**Rs 174319.95**	
12	13.7.1 12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)							
	slab top	1	12.750	5.800			73.950	
		1	39.450	1.000			39.450	
	rounded	1	1.600				1.600	
						Total Quantity	115.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	115.000 sqm	
						Say 115.000 sqm @ Rs 401.21 / sqm	**Rs 46139.15**	
13	13.7.2 12 mm cement plaster finished with a floating coat of neat cement of mix:1:4 (1 cement : 4 fine sand)							
	Septi tank inside	1	15.400	1.800			27.721	
	bottom	1	6.000	1.700			10.200	
	partition wall	2*2	1.700	1.000			6.800	

	roumnded	1	0.279				0.279	
						Total Quantity	45.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	45.000 sqm	
						Say 45.000 sqm @ Rs 386.36 / sqm	**Rs 17386.20**	
14	8.31 Providing and fixing Ist quality ceramic glazed wall tiles conforming to IS: 15622(thickness to be specified by the manufacturer), of approved make, in all colours,shades except burgundy, bottle green, black of any size as approved by Engineerin-Charge,in skirting, risers of steps and dados, over 12 mm thick bed of cementmortar 1:3 (1 cement : 3 coarse sand) and jointing with grey cement slurry @3.3kg per sqm, including pointing in white cement mixed with pigment of matchingshade complete.							
	toilet	11	4.700	1.800			93.060	
	DA toilet	2	5.600	1.800			20.160	
	bath	1	5.800	1.800			10.440	
	urinal portion	3	2.600	1.600			12.480	
	rounded	1	3.860				3.860	
						Total Quantity	140.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	140.000 sqm	
						Say 140.000 sqm @ Rs 1212.78 / sqm	**Rs 169789.20**	
15	11.37 Providing and laying Ceramic glazed floor tiles of size 300x300 mm (thickness to be specified by the manufacturer), of 1st quality conforming to IS : 15622, of approved make, in colours such as White, Ivory, Grey, Fume Red Brown, laid on 20 mm thick cement mortar 1:4 (1 Cement : 4 Coarse sand), including pointing the joints with white cement and matching pigment etc., complete.							
	inside floor	1	12.150	4.800			58.320	
	Rounded	1	1.680				1.680	
						Total Quantity	60.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	60.000 sqm	
						Say 60.000 sqm @ Rs 1091.02 / sqm	**Rs 65461.20**	
16	od209399/2023_2024 :Providing and laying industrial grade antiskid tiles of size 300x300mm with thickness 9mm or nearest with water absorption less than 0.08 % and conforming to I.S. 15622, of approved make, in all colours & shades,laid on 20 mm thick cement mortar 1:4 (1 cement : 4 coarse sand), including grouting the joint with white cement & matching pigments etc. complete.							
	ramp	2	5.200	1.200			12.480	

		1	3.500	1.200			4.200	
	step	3	3.000	0.450			4.051	
	Rounded	1	2.269				2.269	
						Total Quantity	23.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	23.000 sqm	
						Say 23.000 sqm @ Rs 1276.95 / sqm	**Rs 29369.85**	
17	13.43.1 Applying one coat of water thinnable cement primer of approved brand and manufacture on wall surface:Water thinnable cement primer							
	area vide item no 11	1	555.000				555.000	
						Total Quantity	555.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	555.000 sqm	
						Say 555.000 sqm @ Rs 70.64 / sqm	**Rs 39205.20**	
18	13.46.1 Finishing walls with Acrylic Smooth exterior paint of required shade:New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm)							
	out side wall	1	35.300	2.800			98.840	
	Parapet	1	37.100	1.400			51.940	
	rounded	1	4.220				4.220	
						Total Quantity	155.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	155.000 sqm	
						Say 155.000 sqm @ Rs 193.89 / sqm	**Rs 30052.95**	
19	13.83.2 Wall painting with premium acrylic emulsion paint of interior grade, having VOC (Volatile including applying additional coats wherever required to achieve even shade and colour.Two coats							
	toilet inside	10	5.400	1.000			54.000	
	DA toilet	2	6.600	1.000			13.200	
	out	2	4.800	2.800			26.880	
	bath	1	6.500	1.000			6.500	
	partition	2	3.150	2.800			17.640	
		1	5.300	2.800			14.840	
		1	5.500	2.800			15.400	

		1	3.200	2.800			8.960	
		1	4.850	2.800			13.580	
		1	2.500	2.800			7.000	
	urinal partition	2	2.100	1.500			6.301	
	under side slab	1	12.750	5.800			73.950	
		1	39.450	1.000			39.450	
	rounded	1	4.367				4.367	
	door D	2	1.000	2.100			-4.200	
	toilet door	11	0.700	2.100			-16.169	
	ventilator	15	0.600	0.500			-4.500	
	shutter	1	3.000	2.400			-7.199	
						Total Quantity	302.068 sqm	
						Total Deducted Quantity	-32.068 sqm	
						Net Total Quantity	270.000 sqm	
						Say 270.000 sqm @ Rs 134.10 / sqm	**Rs 36207.00**	
20	9.117.1 Providing and fixing factory made uPVC door frame made of uPVC extruded sections having an overall dimension as below (tolerance ±1 mm), with wall thickness 2.0mm (±0.2 mm), corners of the door frame to be jointed with galvanized brackets and stainless steel screws, joints mitred and plastic welded. The hinge side vertical of the frames reinforced by galvanized M.S. tube of size 19 x 19 mm and 1 mm (± 0.1 mm) wall thickness and 3 nos. stainless steel hinges fixed to the frame complete as per manufacturer's specification and direction of Engineer-in-chargeExtruded section profile size 48x40 mm							
	Toilet door 70x210	11	5.600				61.600	
	DA toilet,100x210	2	6.200				12.400	
	rounded	1	1.000				1.000	
						Total Quantity	75.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	75.000 metre	
						Say 75.000 metre @ Rs 260.94 / metre	**Rs 19570.50**	
21	9.118.1 Providing and fixing to existing door frames24 mm thick factory made PVC door shutters made of styles and rails of a uPVC hollow section of size 59x24 mm and wall thickness 2 mm (± 0.2 mm) with inbuilt edging on both sides. The styles and rails mitred and joint at the corners by means of M.S. galvanised/plastic brackets of size 75x220 mm having wall thickness 1.0 mm and stainless steel screws. The styles of the shutter reinforced by inserting galvanised M.S. tube of size 20x20 mm and 1 mm (± 0.1 mm) wall thickness. The lock rail made up of 'H' section, a uPVC hollow section of size 100x24 mm and 2 mm (± 0.2 mm) wall thickness,fixed to the shutter styles by means of plastic/galvanised M.S. 'U' cleats.							

	The shutter frame filled with a uPVC multi-chambered single panel of size not less than 620 mm, having over all thickness of 20 mm and 1 mm (± 0.1 mm) wall thickness. The panels filled vertically and tie bar at two places by inserting horizontally 6 mm galvanised M.S. rod and fastened with nuts and washers, complete as per manufacturer's specification and direction of Engineer-in-charge(For W.C. and bathroom door shutter).							
	Toilet door 70x210	11	0.700	2.100			16.170	
	DA toilet,100x210	2	1.000	2.100			4.200	
	rounded	1	0.630				0.630	
						Total Quantity	21.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	21.000 sqm	
						Say 21.000 sqm @ Rs 2072.49 / sqm	**Rs 43522.29**	
22	9.147B.1 543SUB HEAD : 9 - WOOD & PVC WORK9.147BProviding and fixing factory made uPVC white colour fixed glazed windows/ventilators comprising of uPVC multi-chambered frame and mullion (where everrequired) extruded profiles duly reinforced with 1.60 ± 0.2 mm thick galvanizedmild steel section made from roll forming process of required length (shape &size according to uPVC profile), , uPVC extruded glazing beads of appropriatedimension, EPDM gasket, G.I fasteners 100 x 8 mm size for fixing frame to finishedwall, plastic packers, plastic caps and necessary stainless steel screws etc.Profile of frame shall be mitred cut and fusion welded at all corners, mullion (ifrequired) shall be also fusion welded including drilling of holes for fixinghardware's and drainage of water etc. After fixing frame the gap between frameand adjacent finished wall shall be filled with weather proof silicon sealant overbacker rod of required size and of approved quality, all complete as per approveddrawing & direction of Engineer-in-Charge. (Single / double glass panes andsilicon sealant shall be paid separately). Note: For uPVC frame, sash and mullion extruded profiles minus 5% tolerancein dimension i.e. in depth & width of profile shall be acceptable.Fixed window / ventilator made of (small series) frame 47 x 50 mm & mullion 47x 68 mm both having wall thickness of 1.9 ± 0.2 mm and single glazing bead ofappropriate dimension. (Area upto 0.75 sqm.)							
	for ventilator	15	0.600	0.500			4.500	
						Total Quantity	4.500 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	4.500 sqm	
						Say 4.500 sqm @ Rs 7626.06 / sqm	**Rs 34317.27**	
23	10.3 Providing and fixing in position collapsible steel shutters with vertical channels 20x10x2 mm and braced with flat iron diagonals 20x5 mm size, with top and bottom rail of T-iron 40x40x6 mm, with 40 mm dia steel pulleys, complete with bolts, nuts,locking arrangement, stoppers, handles, including applying a priming coat of approved steel primer .							
	Front shutter	1	3.500	2.400			8.400	

	Rounded	1	0.600				0.600	
						Total Quantity	9.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	9.000 sqm	
						Say 9.000 sqm @ Rs 10205.93 / sqm	**Rs 91853.37**	
24	10.28 Providing and fixing stainless steel (Grade 304) railing made of Hollow tubes, channels, plates etc., including welding, grinding, buffing, polishing and making curvature (wherever required) and fitting the same with necessary stainless steel nuts and bolts complete, i/c fixing the railing with necessary accessories & stainless steel dash fasteners, stainless steel bolts etc., of required size on the top of the floor or the side of waist slab with suitable arrangement as per approval of Engineer-in-charge, (for payment purpose only weight of stainless steel members shall be considered excluding fixing accessories such as nuts, bolts, fasteners etc.)							
	hand rail	2	6.000			20.0	240.000	@20kg/m
						Total Quantity	240.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	240.000 kg	
						Say 240.000 kg @ Rs 677.34 / kg	**Rs 162561.60**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
	4 Appendix D- construction of Parking Area							
1	16.78.1 Construction of granular sub- base by Providing close graded Material conforming to specifications, mixing in a mechanical mix plant at OMC, Carriage of mixed material by tippers to work site, for all leads & lifts, spreading in uniform layers of specified thickness with motor grader on prepared surface and compacting with vibratory power roller to achieve the desired density, complete as per specifications and directions of Engineer-in- Charge.With Material conforming to Grade - I (size range 75 mm to 0.075 mm) having CBR Value- 30							
	Auction hall front	1	40.000	25.000	0.150		150.000	
	side	2	6.000	6.000	0.150		10.800	
	AH west side	1	40.000	10.000	0.150		60.000	
	for road	1	30.000	6.000	0.150		27.000	
	rounded	1	4.200				4.200	
						Total Quantity	252.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	252.000 cum	
						Say 252.000 cum @ Rs 2963.59 / cum	**Rs 746824.68**	
2	16.80							

	Construction of dry lean cement concrete sub base over a prepared sub - grade with coarse and fine aggregate conforming to IS : 383, the size of coarse aggregate not exceeding 25 mm, aggregate cement ration not to exceed 15:1, aggregate gradation after blending to be as per specification, cement content not to be less than 150 Kg/ cum, optimum moisture content to be determined during trial length construction, concrete strength not to be less than 10 Mpa at 7 days, mixed in a batching plant, transported to site, for all leads & lifts, laid with a mechanical paver, compacting with 8-10 tonne vibratory roller, finishing and curing etc. complete as per direction of Engineer-in-charge							
	Auction hall front	1	40.000	25.000	0.150		150.000	
	side	2	6.000	6.000	0.150		10.800	
	AH west side	1	40.000	10.000	0.150		60.000	
	for road	1	30.000	6.000	0.150		27.000	
	rounded	1	4.200				4.200	
						Total Quantity	252.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	252.000 cum	
						Say 252.000 cum @ Rs 4569.25 / cum	**Rs 1151451.00**	
3	16.43.1 Providing and laying design mix cement concrete of M-30 grade, in roads/ taxi tracks/ runways, using cement content as per design mix, using coarse sand and graded stone aggregate of 40 mm nominal size in appropriate proportions as per approved & specified design criteria, providing dowel bars with sleeve/tie bars wherever required, laying at site, spreading and compacting mechanically by using needle and surface vibrators, levelling to required slope/ camber, finishing with required texture, including steel form work with sturdy M.S. channel sections, curing, making provision for contraction / expansion, construction & longitudinal joints (10 mm wide x 50 mm deep) by groove cutting machine, providing and filling joints with approved joint filler and sealants, complete all as per direction of Engineer-in-charge (Item of joint fillers, sealants, dowel bars with sleeve/tie bars to be paid separately). Note: Cement content considered in M-30 is @340 kg/cum. Excess/less cement used as per design mix is payable/ recoverable separately.Cement concrete prepared with batch mixing machine							
	Auction hall front	1	40.000	25.000	0.150		150.000	
	side	2	6.000	6.000	0.150		10.800	
	AH west side	1	40.000	10.000	0.150		60.000	
	for road	1	30.000	6.000	0.150		27.000	
	rounded	1	4.200				4.200	
						Total Quantity	252.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	252.000 cum	
						Say 252.000 cum @ Rs 10302.33 / cum	**Rs 2596187.16**	
4	5.22A.6							

	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Thermo - Mechanically Treated bars of grade Fe-500D or more							
	qty of CC	1	307.800			60.0	18468.000	@60Kg/m3
	rounded	1	15.000				15.000	@75Kg/m3
						Total Quantity	18483.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	18483.000 kg	
						Say 18483.000 kg @ Rs 98.30 / kg	**Rs 1816878.90**	
5	16.44 Extra for providing and mixing hardening compound of approved quality as per manufacturer's specification in cement concrete.							
	qty of cc 307.8*340=104652(2093 bags	1	2093.000			0.2	418.600	@.20 Kg/bag
	Rounded	1	6.400				6.400	@.20 Kg/bag
						Total Quantity	425.000 Litre	
						Total Deducted Quantity	0.000 Litre	
						Net Total Quantity	425.000 Litre	
						Say 425.000 Litre @ Rs 59.86 / Litre	**Rs 25440.50**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
5 Appendix E - Construction of Drain								
1	2.8.1 Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil							
	main drain from Auction hall to sump	1	50.000	1.300	1.000		65.000	
						Total Quantity	65.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	65.000 cum	
						Say 65.000 cum @ Rs 296.94 / cum	**Rs 19301.10**	
2	2.6.1 Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas							

	(exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil							
	Pit of sump	1	8.200	4.000	2.450		80.360	
	soak pit 2m dia	1	3.140	1*1	2.100		6.594	
	round of	1	3.046				3.046	
						Total Quantity	90.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	90.000 cum	
						Say 90.000 cum @ Rs 214.03 / cum	**Rs 19262.70**	
3	4.1.8 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)							
	for drain	1	50.000	1.300	0.150		9.750	
	sump bottom	1	8.200	4.000	0.200		6.560	
	round of	1	0.690				0.690	
						Total Quantity	17.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	17.000 cum	
						Say 17.000 cum @ Rs 6814.89 / cum	**Rs 115853.13**	
4	5.1.2 Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level:1:1:5:3 (1 cement 1.5 coarse sand :3 graded stone aggregate 20 mm nominal size							
	drain bottom slab	1	50.000	1.200	0.100		6.000	
	side wall	2	50.000	1.000	0.200		20.000	
	cover slad for drain 50/.5	100	1.000	0.500	0.150		7.500	
	cover slab sump	16	3.500	0.500	0.120		3.360	
	do beam	1	7.500	0.300	0.300		0.675	
	cover slab soak pit	1	3.140	1.100	0.120		0.415	
	round	1	0.050				0.050	
						Total Quantity	38.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	38.000 cum	

	Say 38.000 cum @ Rs 9085.14 / cum						**Rs 345235.32**	
5	5.9.1 Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete							
	side wall drain out	2	50.000	1.000			100.000	
	side wall drain in	2	50.000	0.900			90.000	
	Total Quantity						190.000 sqm	
	Total Deducted Quantity						0.000 sqm	
	Net Total Quantity						190.000 sqm	
	Say 190.000 sqm @ Rs 335.31 / sqm						**Rs 63708.90**	
6	5.9.5 Centering and shuttering including strutting, etc. and removal of form for:Lintels, beams, plinth beams, girders bressumers and cantilevers							
	For cover slab drain 105 x 50 x 15 cm	100	3.100	0.150			46.500	
	For cover slab Effluent tank sides	16	8.000	0.120			15.360	
	beam	1	7.500	0.900			6.750	
	Rounded	1	1.390				1.390	
	Total Quantity						70.000 sqm	
	Total Deducted Quantity						0.000 sqm	
	Net Total Quantity						70.000 sqm	
	Say 70.000 sqm @ Rs 649.82 / sqm						**Rs 45487.40**	
7	5.22A.1 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Mild steel and Medium Tensile steel bars							
	Qty of CC 38	1	38.000			90.0	3420.000	
	Total Quantity						3420.000 kilogram	
	Total Deducted Quantity						0.000 kilogram	
	Net Total Quantity						3420.000 kilogram	
	Say 3420.000 kilogram @ Rs 96.68 / kilogram						**Rs 330645.60**	
8	50.6.1.1 Solid block masonry using pre cast solid blocks (factory made) of size 40x20x20cm or nearest available size confirming to IS 2185 part 1 of 1979 for foundation and plinth with thickness 20 cm and above in: CM 1:6 (1 cement : 6 coarse sand) etc complete							
	tank side wall	1	21.900	0.200	2.500		10.950	

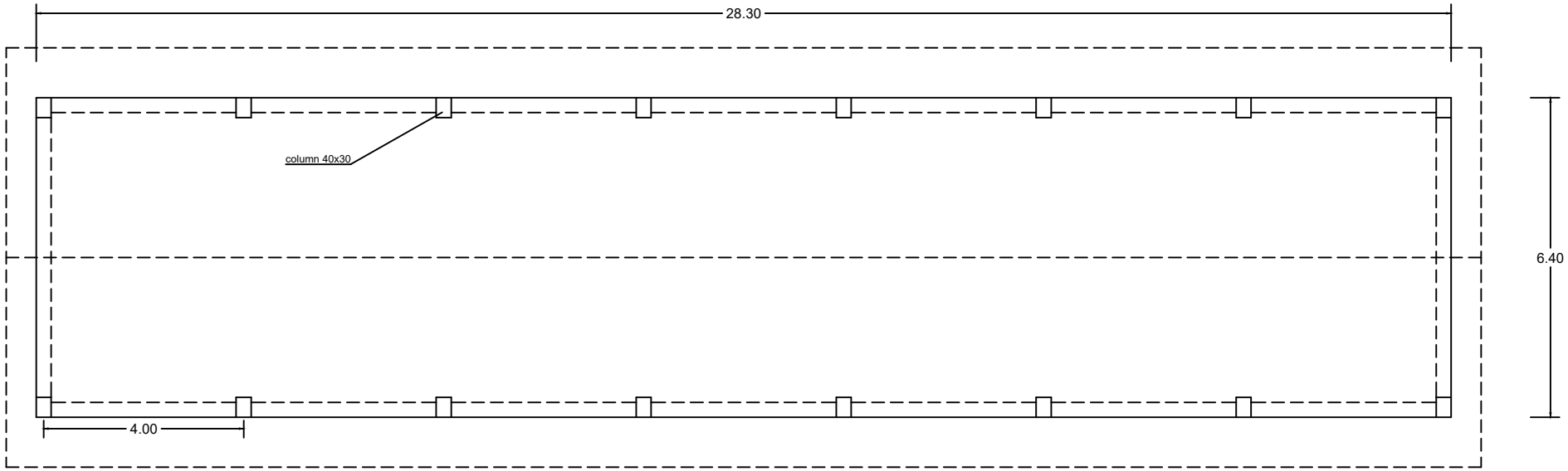
	soak pit 2.00m dia - bottom	1	6.280	0.200	0.300		0.377	
	Rounded	1	0.673				0.673	
						Total Quantity	12.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	12.000 cum	
						Say 12.000 cum @ Rs 5908.32 / cum	**Rs 70899.84**	
9	6.23 Honey-comb brick work 10/11.4 cm thick with common burnt clay bricks of class designation 7.5 in super structure above plinth level upto floor V level with cement mortar 1:4 (1 cement : 4 coarse sand).							
	soak pit 2.00m dia - bottom	1	6.280	1.300			8.165	
	Rounded	1	0.835				0.835	
						Total Quantity	9.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	9.000 sqm	
						Say 9.000 sqm @ Rs 699.37 / sqm	**Rs 6294.33**	
10	13.7.2 12 mm cement plaster finished with a floating coat of neat cement of mix:1:4 (1 cement : 4 fine sand)							
	for Drain side wall - inside	1	50.000	2.600			130.000	
	Effluent tank side wall	2	31.600	2.500			158.000	
	cross wall	2	3.200	2.500			16.000	
	bottom	1	7.600	3.200			24.320	
	Rounded	1	1.680				1.680	
						Total Quantity	330.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	330.000 sqm	
						Say 330.000 sqm @ Rs 386.36 / sqm	**Rs 127498.80**	

Sl No	Description	No	L	B	D	CF	Quantity	Remark
	6 Sub soil investigation							
	Lump-Sum Total						**Rs 1500000.00**	

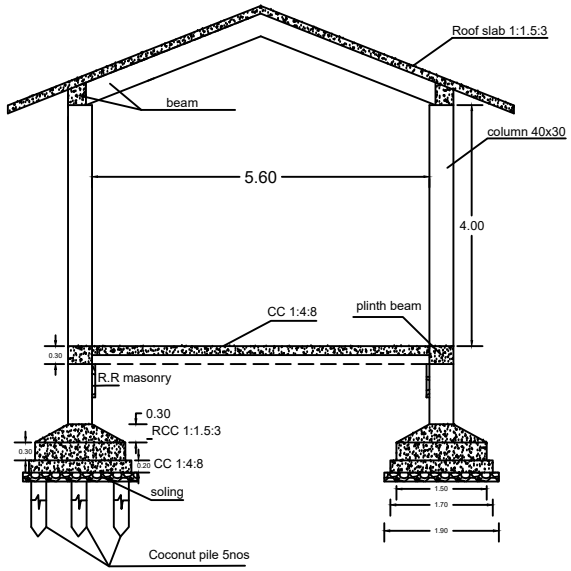
	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**7 Water supply and sanitary arrangement**							
	Lump-Sum Total						**Rs 1900000.00**	

	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**8 Electrification and yard lighting**							
Lump-Sum Total						**Rs 1000000.00**		
	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**9 Unforeseen charges @2.5%**							
Lump-Sum Total						**Rs 4990000.00**		
	Provision for GST payments (in %) @						**18.0%**	
Amount reserved for GST payments						**35995983.04**		
Total						**235973667.04**		
Lumpsum for round off						**26332.96**		
TOTAL Rs 236000000.00								
Rounded Total Rs 23,60,00,000								
Rupees Twenty Three Crore Sixty Lakh Only								

(Cost Index Applied for this estimate is 35.59%)



FLC Auction hall plan



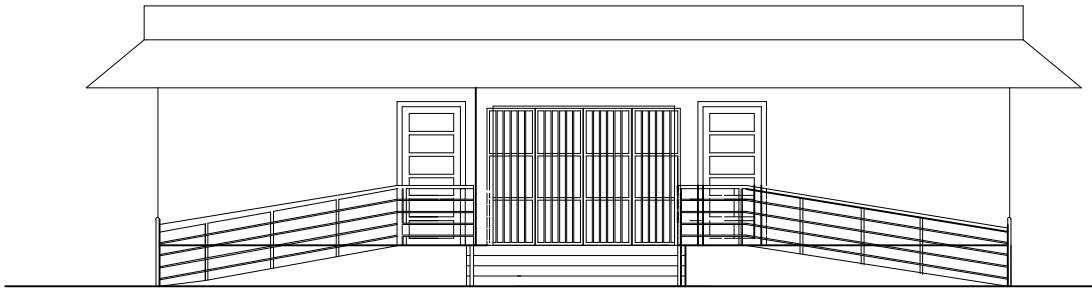
FLC Auction hall cross section

KSCADC

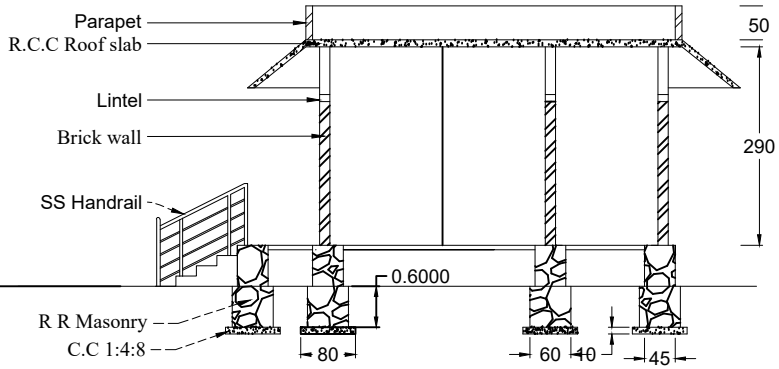
KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION

DEVELOPMENT OF VIPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT VALIYATHAMPARAMBU

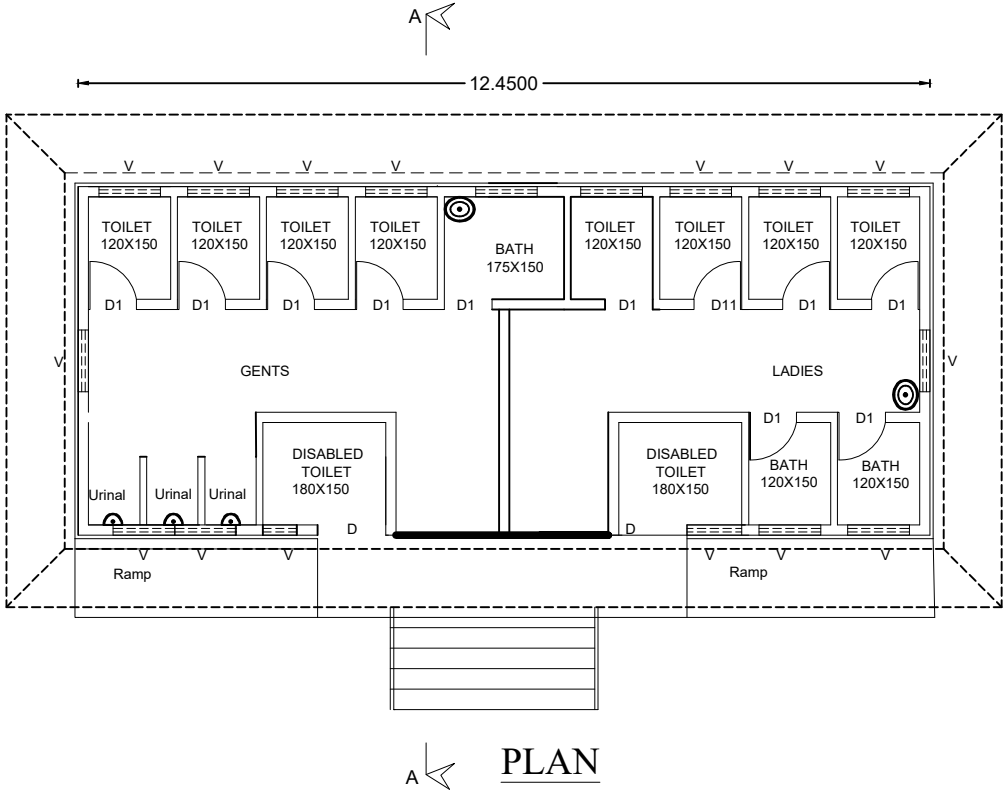
DRAWING NO:		ASSISTANT ENGINEER:		**ASSISTANT ENGINEER:** SIGNATURE:	**ASSISTANT EXECUTIVE ENGINEER:** SIGNATURE:
DATE:		DRAWN:			
TYPE:	**DRAWING**	**REVISION**		**STRUCTURAL CONSULTANT:** DESIGNED & CHECKED BY	**CHIEF ENGINEER:** SIGNATURE:
TITLE:	FLC AUCTION HALL PLAN & SECTION	1.			
		2.			



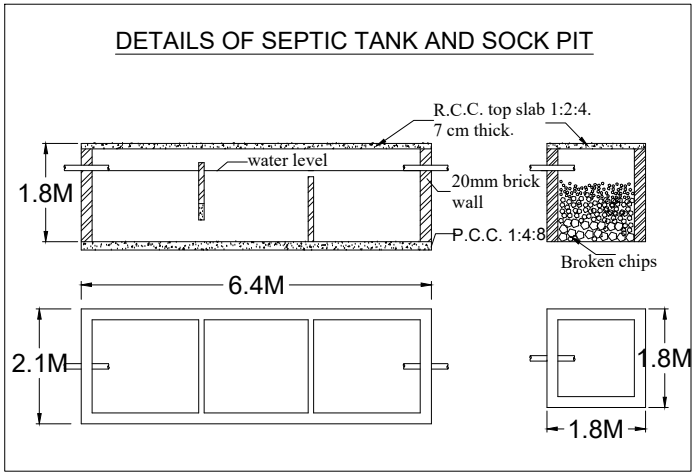
ELEVATION



Section on A A



PLAN

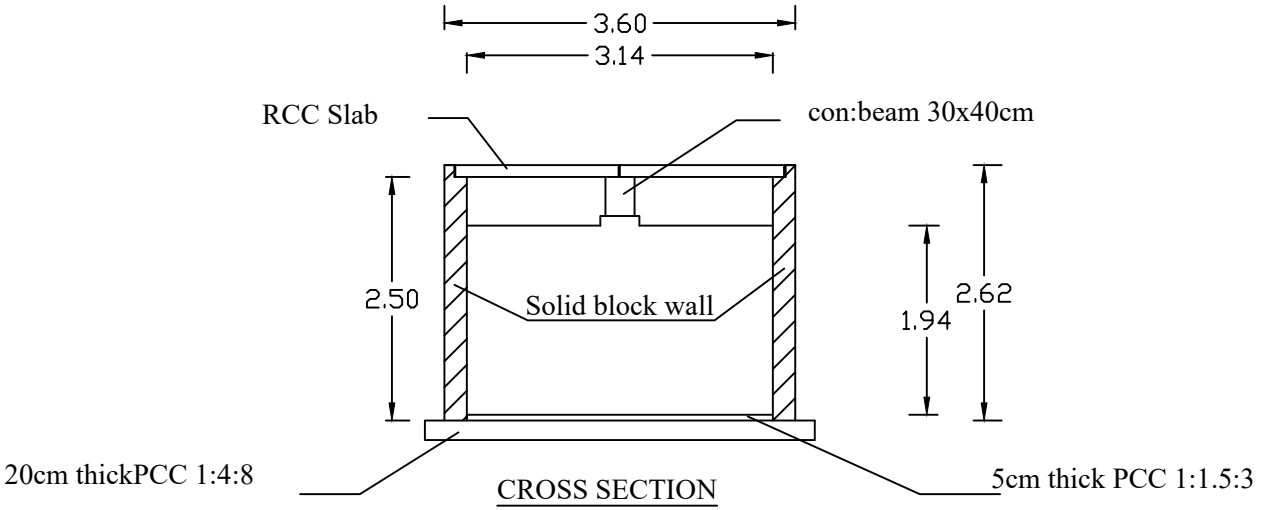


KSCADC

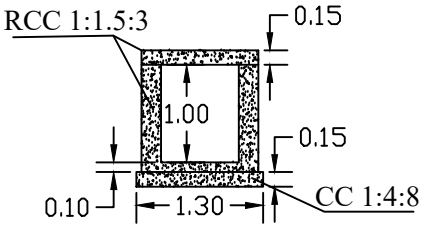
KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION

DEVELOPMENT OF VIPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT VALIYATHAMPARAMBU

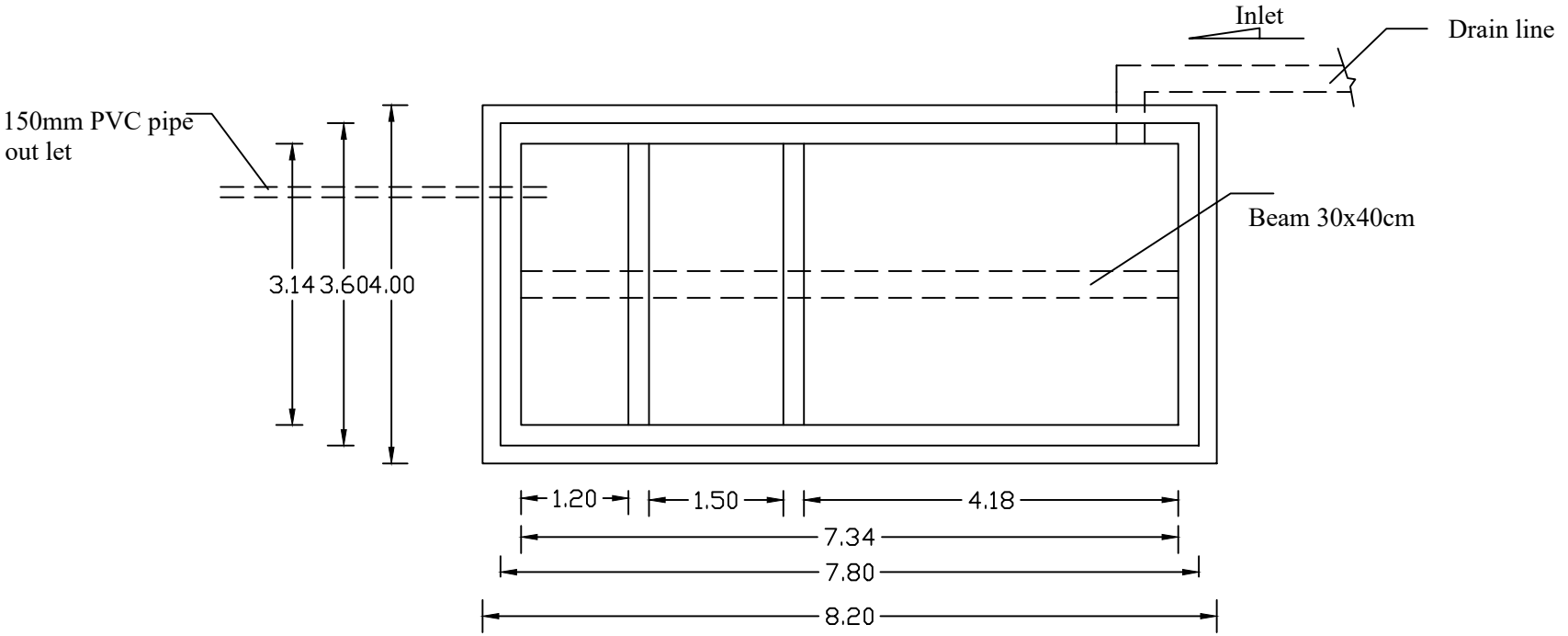
DRAWING NO:		ASSISTANT ENGINEER:		**ASSISTANT ENGINEER:** SIGNATURE:	**ASSISTANT EXECUTIVE ENGINEER:** SIGNATURE:
DATE:		DRAWN:			
TYPE:	**DRAWING**	**REVISION**		**STRUCTURAL CONSULTANT:** DESIGNED & CHECKED BY	**CHIEF ENGINEER:** SIGNATURE:
TITLE:	TOILET BLOCK	1.			
		2.			



CROSS SECTION



Drain Cross section



PLAN

KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION	DEVELOPMENT OF VIPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT VALIYATHAMPARAMBU				
	DRAWING NO:		ASSISTANT ENGINEER:	**ASSISTANT ENGINEER:** SIGNATURE:	**ASSISTANT EXECUTIVE ENGINEER:** SIGNATURE:
	DATE:		DRAWN:		
	TYPE:	**DRAWING**	**REVISION**	**STRUCTURAL CONSULTANT:** DESIGNED & CHECKED BY	**CHIEF ENGINEER:** SIGNATURE:
	TITLE:	FISH LANDING CENTRE DRAIN AND TREATMENT TANK	1. 2.		

ANNEXURE 4

Name of work : DEVELOPMENT OF VYPIN -MUNAMBAM COASTAL STRETCH INCLUDINGCOASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT PUTHENKADAPPURAM

ESTIMATE REPORT

This estimate is prepared for the construction of Fish landing centre and associated amenities based on the study conducted by IIT Madras wherein different types of groynes are proposed for coastal protection.In this estimate, a series of 2 transitional groynes are proposed. Groynes of length 180m and 150m are proposed. A filter layer of 1kg to 10kg category stone, Core layer using 100 to 300 kg stones , Toe Mound using 500 to 800 kg stones ,Armour layer using 1.5T to 2.5T stones proposed here. In addition to that 2T tetrapods of 1.96m Thickness and 4T tetrapods of 2.50m Thickness is provided for armour layer.Provision for Auction hall buidling of size 28.3m x 6.4m is included in the estimate. For the auction hall, coconut piling oflength 6m long is provided for foundation. RCC M20 provided for foundations, centering & shuttering, Reinforcement cement concrete work (M20) in walls is provided for super structure. Necessary Steel reinforcement, plastering and painting works are also included in the Auctionhall. Provision for construction of a toilet block of size 12.5m x 5.1m is also included in the estimate. For the toilet block, RR masonry with cement mortar 1:6 is provided for the foundation.Solid block masonry of size 30x20x15cm and 40x20x10 cm are provided for superstructure. Ceramic tiling is provided in the floor and in the bathroom region. Necessary fittings are also provided for toilet block. Other provisions in the estimate include concrete parking area proposed near the the Auction hall. Provision for the construction of drain is also included in theestimate. Lump sum provisions for sea wall strengthening, sub soil investigation, water supply and sanitary arrangement, Electrification and yard lighting are also included in the estimate. Lumpsum provision for unforeseen expenses @2.5% are also included in the estimate. Total amount of estimate comes to Rupees 267500000/-(Twenty Six crore Seventy Five lakhs) The estimate is prepared in PRICE based on DSR 2018 and cost index is 35.59%. The provisions adopted in the estimate are adequate for proper completion of work

DEVELOPMENT OF VYPIN - MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION AND CONSTRACTION OF FISH LANDING CENTRE AT PUTHENKADAPPURAM

COST ABSTRACT

1	*APPENDIX - A GROYNE*	*Rs.*	*15 18 22 781/-*
2	*APPENDIX B- CONSTRUCTION OF AUCTION HALL*	*Rs.*	*31 90 663/-*
3	*Appendix C- construction of Toilet block*	*Rs.*	*24 10 666/-*
4	*Appendix D- construction of Parking Area*	*Rs.*	*78 60 744/-*
5	*Appendix E - Construction of Drain*	*Rs.*	*11 44 187/-*
6	*Seawall Strengthening*	*Rs.*	*2 36 00 000/-*
7	*Sub soil investigation*	*Rs.*	*15 00 000/-*
8	*Water supply and sanitary arrangement*	*Rs.*	*25 00 000/-*
9	*Electrification and yard lighting*	*Rs.*	*10 00 000/-*
10	*Unforeseen expenses @ 2.5%*	*Rs.*	*49 00 000/-*
11	*Sub Total*	*Rs.*	*19 99 29 041/-*
12	*GST @ 18%*	*Rs.*	*3 59 87 227/-*
13	*Total Amount including GST 18%*	*Rs.*	*23 59 16 268/-*
14	*Lumpsum for Round off*	*Rs.*	*83 732/-*
15	*Total Amount*	*Rs.*	*23 60 00 000/-*
16	*Consultancy @5%*	*Rs.*	*1 18 00 000/-*
17	*GST on consultancy @ 18%*	*Rs.*	*21 24 000/-*
18	*Round off*	*Rs.*	*76 000/-*
19	*Grand Total*	*Rs.*	*25 00 00 000/-*

Rupees Twenty Five Crore Only

DEVELOPMENT OF VYPIN -MUNAMBAM COASTAL STRETCH INCLUDINGCOASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT PUTHENKADAPPURAM

General Abstract

(Dsor year: **2018**,Cost Index Applied for this estimate is **35.59**%)

Sl No	Heading Description	Amount
1	**APPENDIX A - GROYNE**	151822780.74
2	**APPENDIX B CONSTRUCTION OF AUCTION HALL**	3190663.46
3	**Appendix C- construction of Toilet block**	2410665.96
4	**Appendix D- construction of Parking Area**	7860743.54
5	**Appendix E - Construction of Drain**	1144187.11
6	**Seawall Strengthening**	23600000.00
7	**Sub soil investigation**	1500000.00
8	**Water supply and sanitary arrangement**	2500000.00
9	**Electrification and yard lighting**	1000000.00
10	**Unforeseen charges @ 2.5%**	4900000.00
	Provision for GST payments (in %) @	**18.0%**
	Amount reserved for GST payments	**35987227.35**
	Total	**235916268.35**
	Lumpsum for round off	**83731.65**
		TOTAL Rs 236000000.00
		Rounded Total Rs 23,60,00,000
		Rupees Twenty Three Crore Sixty Lakh Only

(Cost Index Applied for this estimate is 35.59%)

DEVELOPMENT OF VYPIN -MUNAMBAM COASTAL STRETCH INCLUDINGCOASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT PUTHENKADAPPURAM

Detailed Estimate

(Dsor year: **2018**,Cost Index Applied for this estimate is **35.59**%)

Sl No	Description	No	L	B	D	CF	Quantity	Remark
	1 APPENDIX A - GROYNE							
1	od206893/2023_2024 Moulding and supplying cement concrete 1.6m3 (4T) tetrapod with graded aggregate of 40% 75mm to 40 mm, 30% 40 to 20mm, 30% 20 to 5mm using 380 kg cement /m3 pf cpmcrete as per approved mix design of mix proportion 0.5:,1.46:3.22 by weight of water cement, fine aggregate, course aggregate (specific gravity of fine aggregate and course aggregateshould not be less than 2.73 and 2.5 respectively) and the cement shall be 43 grade or higher) minimum cube strength requirement (i) @ 7 day - 20N/mm2 (ii) @ 28 day - 30N/mm2 and minimum density of concrete 2.5 g/cc. including hire and operational charge of tools and plants moulding and rehandling and stacking charge etc complete according to specification and instructions of Engineer							
	ARMOUR LAYER, 4T tetrapods at 2.50m Thick	3272					3272.000	
						Total Quantity	3272.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	3272.000 each	
						Say 3272.000 each @ Rs 15999.39 / each	**Rs 52350004.08**	
2	od206895/2023_2024 Conveying 1.6m3 (4T) tetrapods from stacking and placing in two layer according to specification and forming the armour layer of break water to lines and levels at depth of water 8m and above including hire and operational charges of tools and plants etc complete							
	ARMOUR LAYER, 4T tetrapods at 2.50m Thick	3272					3272.000	
						Total Quantity	3272.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	3272.000 each	
						Say 3272.000 each @ Rs 2042.97 / each	**Rs 6684597.84**	
3	65.103 Moulding and supplying 0.8 cum(2T) tetrapod with graded aggregate of 40% 75mm to 40mm, 30% 40mm to 20mm and 30% 20mm to 6mm using 380kg cement/ m3 of concrete as per approved mix design of mix proportion 0.5:1:1. 46:3.22 by weight of water cement, fine aggregate, coarse aggregate (specific gravity of fine aggregate and coarse aggregate should not be less than 2.73 and 2.5 respectively) and the cement shall be 43 grade or higher) minimum cube strength requirement (i) @7 day - 20 N/mm2 (ii) @ 28							

	day - 30 N/mm2 and minimum density of concrete 2.5 g/cc including hire and operational charges of tools and plants, mould, curing, rehandling and stacking charges etc., complete as per the instruction of departmental officers at site .							
	ARMOUR LAYER, 2T tetrapods at 1.96m Thick	1725					1725.000	
						Total Quantity	1725.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	1725.000 each	
						Say 1725.000 each @ Rs 7596.47 / each	**Rs 13103910.75**	
4	65.104 Conveying 0.8cum (2T) tetrapod from stacking yard and placing in position in two layers according to specification and forming the armour layer of breakwater to lines and levels over the secondary armour layer including hire and operational charges of tools and plants etc., complete as per the direction of the departmental officers at site							
	ARMOUR LAYER, 2T tetrapods at 1.96m Thick	1725					1725.000	
						Total Quantity	1725.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	1725.000 each	
						Say 1725.000 each @ Rs 912.92 / each	**Rs 1574787.00**	
5	2.6.1 Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil							
	From Chainage 0 to 40m	2	40.000	35.000	2.000		5600.000	
						Total Quantity	5600.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	5600.000 cum	
						Say 5600.000 cum @ Rs 214.03 / cum	**Rs 1198568.00**	
6	od206899/2023_2024 Supplying and laying Geotextile 120 gram per sqm membrane (best quality) including providing necessary overlaps, all cost, conveyance, labour charges etc complete as per the instruction of departmental officers at site.							
	Geotextile Layer							

	Northern Groyne 15m Chainage 0 to 150M	1	150.000	40.000			6000.000	
	Southern Groyne 170m							
	Chainage 0 to 180m	1	180.000	40.000			7200.000	
						Total Quantity	13200.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	13200.000 sqm	
						Say 13200.000 sqm @ Rs 83.20 / sqm	**Rs 1098240.00**	
7	od206900/2023_2024 [Based on 65.32]Supplying blasted rock from approved quarry to sorting site and sorting the stones into 1.5T to 2.5T(70% of stones > 2.0T) category stones of approved quality having specific gravity ranges from 2.65 to 2.8 for forming the primary armour and berm of rubble mount breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and the measurements of catagorised stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater and forming the primary armour of the breakwater to the lines and levels as per approved drawings with tolerance of +/- 20 cm in final levels including all cost and labour charges, hire and operational charges of mobile crane and excavator, rehandling, placing and packing and using mobile crane, inspecting the profile once in a week and cost of spalls/quarry muck and hire of machineries for forming the roadway for movement of lorries/tippers/cranes etc including all incidental charges etc complete as per the direction of departmental officers at site Ernakulam District							
	Armour layer using 1.5T to 2.5T stones (Assuming 1/3 void and sp.gravity 2.7)							
	Northern Groyne 150m Chainage 0 to150M	1	3768.380				3768.380	
	Southern Groyne 180m							
	Chainage 0 to 180m	1	3266.530				3266.530	
						Total Quantity	7034.910 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	7034.910 tonne	
						Say 7034.910 tonne @ Rs 1781.12 / tonne	**Rs 12530018.90**	
8	od206901/2023_2024 Supplying blasted rock from approved quarry to sorting site and sorting the stones into 500kg to 800kg category stones of approved quality having specific gravity ranges from 2.65 to 2.8 for forming the primary armour and berm of rubble mount breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and the measurements of catagorised stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater and forming the primary armour of the breakwater							

	to the lines and levels as per approved drawings with tolerance of +/- 20 cm in final levels including all cost and labour charges, hire and operational charges of mobile crane and excavator, rehandling, placing and packing and using mobile crane, inspecting the profile once in a week and cost of spalls/quarry muck and hire of machineries for forming the roadway for movement of lorries/tippers/cranes etc including all incidental charges etc complete as per the direction of departmental officers at site Ernakulam District							
	Toe Mound using 500 to 800 kg stones (Assuming 1/3 void and sp.gravity 2.7)							
	Northern Groyne 150m Chainage 0 to 150m	1	6940.760		1.050		7287.799	5% sinkage added
	Head	1	630.360		1.050		661.878	5% sinkage added
	Southern Groyne 130m							
	Chainage 0 to 130m	1	6016.440		1.050		6317.262	
	Head	1	617.190		1.050		648.050	
						Total Quantity	14914.989 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	14914.989 tonne	
						Say 14914.989 tonne @ Rs 1781.12 / tonne	**Rs 26565385.21**	
9	od208955/2023_2024 [Based on 65.30]Supplying granite blasted rock from approved quarry to sorting site by lorry/ tipper, and sorting the stones into 100kg to 300kg category stones of approved quality having specific gravity ranging from 2.65 to 2.8 for forming the core of rubble mound breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and measurements of categorized stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater and rehandling and forming the core of the break water to the lines and levels as per the approved drawings and inspecting the profile once in a week with tolerance of +/- 20cm in final levels including all cost and labour charges, hire and operational charges of light crane and cost of spalls/ quarry muck and labour for forming the roadway for movement of lorries/ tippers / cranes etc including all incidental charges etc complete as per the direction of departmental officers at site Ernakulam District							
	Core layer using 100 to 300 kg stones (Assuming 1/3 void and sp.gravity 2.7)							
	Northern Groyne 150m Chainage 0 to 150m	1	7983.440		1.100		8781.784	10% sinkage added
	Head	1	499.380		1.100		549.318	10% sinkage added

	Southern Groyne 130m							
	Chainage 0 to 130m	1	6920.260		1.100		7612.287	
	Head	1	475.380		1.100		522.918	
						Total Quantity	17466.307 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	17466.307 tonne	
						Say 17466.307 tonne @ Rs 1610.75 / tonne	**Rs 28133854.00**	
10	od208956/2023_2024 Supplying granite quarry run from approved quarry to sorting site by lorry/ tipper, and sorting the stones into 1 kg to 10 kg category stones of approved quality with specific gravity ranging from 2.65 to 2.8 for forming the filter layer of breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and the measurements of categorized stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater including conveyance from sorting platform and dumping stones using tippler (3.5x2.5 sqm size) or any suitable methods installed at site on a moving crane having a capaciaty of not less than 20T and placing the stones at sea bed in uniform layer of design thickness for forming filter layer of breakwater as per the approved drawing and design and inspecting the profile once in a week including hire and operational charges of T & P, tippler, crane and all incidental charges etc. complete as per the direction of departmental officers at site. Eranakulam District							
	Filter layer using 1 to 10 kg stones (Assuming 1/3 void and sp.gravity 2.7)							
	Northern Groyne 150m Chainage 0 to 150m	1	2452.230				2452.230	
	Head	1	330.040				330.040	
	Southern Groyne 180m							
	Chainage 0 to 180m	1	2125.650				2125.650	
	Head	1	325.040				325.040	
						Total Quantity	5232.960 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	5232.960 tonne	
						Say 5232.960 tonne @ Rs 1640.26 / tonne	**Rs 8583414.97**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
2 APPENDIX B CONSTRUCTION OF AUCTION HALL								

1	2.8.1 Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil							
	column footing	16	2.100	2.100	1.900		134.064	
	below out side plinth beam	2*7	3.700	0.450	0.600		13.986	
	cross beam	2	5.800	0.450	0.600		3.132	
	rounded	1	3.818				3.818	
						Total Quantity	155.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	155.000 cum	
						Say 155.000 cum @ Rs 296.94 / cum	**Rs 46025.70**	
2	od206894/2023_2024 Supplying and stacking good quality coconut piles							
	For pile 16 x5 Nos =80 Nos	80	6.000				480.000	
						Total Quantity	480.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	480.000 metre	
						Say 480.000 metre @ Rs 107.64 / metre	**Rs 51667.20**	
3	od206896/2023_2024 Coconut Pile- Driving down coconut pile to lines and levels through soft to medium clay soil strata including all hire charges and labour for fixing, staging platform and all other appliances necessary for pile driving down after pointing the bottom end. Details of one post of 6m long 15 numbers per day 6x15=90m.							
	For coconut pile	80	6.000				480.000	
						Total Quantity	480.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	480.000 metre	
						Say 480.000 metre @ Rs 216.92 / metre	**Rs 104121.60**	
4	od206897/2023_2024 Cutting and removing the excess length of wooden piles to lines and levels and removing the cut end of piles and stacking within 150m							
	excess length of pile	16	1.000				16.000	
						Total Quantity	16.000 metre	

						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	16.000 metre	
						Say 16.000 metre @ Rs 154.21 / metre	**Rs 2467.36**	
5	2.18.1 Close timbering over areas including strutting, shoring and packing cavities (wherever required) etc. complete (Measurements to be taken of the face area timbered):Depth not exceeding 1.5 m							
	column excavation side	16*4	2.000	1.200			153.600	
	rounded	1	1.400				1.400	
						Total Quantity	155.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	155.000 sqm	
						Say 155.000 sqm @ Rs 136.88 / sqm	**Rs 21216.40**	
6	od206898/2023_2024 Providing and laying filter media with granular crushed aggregates as per specification to a thickness of not less than 600 mm with smaller size towards the soil and bigger size towards the wall and providing over the entire surface behind abutment, wing wall, return wall to the full height, compacted to firm condition complete as per drawing and technical specification Clause 1204.3.8 of MoRD ncluding cost of all materials ,conveyance,labour charges, etc. complete 							
	bottom of column footing	16	1.900	1.900	0.300		17.328	
	rounding	1	0.672				0.672	
						Total Quantity	18.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	18.000 cum	
						Say 18.000 cum @ Rs 1679.73 / cum	**Rs 30235.14**	
7	50.2.3.1 Pumping or Bailing out water and removing slush etc by using pump set including cost of labour, oil hire charges of pumpset, etc complete							
	For earth work 16 column	2	8.000				16.000	
	For coconut pilling	1	8.000				8.000	
	cc for footing & soling	1	8.000				8.000	
	reinforcement work,shuttering@ concrete for footing	4	8.000				32.000	

						Total Quantity	64.000 hour	
						Total Deducted Quantity	0.000 hour	
						Net Total Quantity	64.000 hour	
						Say 64.000 hour @ Rs 284.60 / hour	**Rs 18214.40**	
8	4.1.8 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)							
	column C1 to C16	16	1.700	1.700	0.200		9.248	
	below plinth beam	2*7	3.700	0.450	0.100		2.331	
	cross beam	8	5.600	0.450	0.100		2.016	
	AH floor	7	5.700	3.700	0.150		22.145	
	rounded	1	0.260				0.260	
						Total Quantity	36.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	36.000 cum	
						Say 36.000 cum @ Rs 6814.89 / cum	**Rs 245336.04**	
9	5.1.2 Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level:1:1:5:3 (1 cement 1.5 coarse sand :3 graded stone aggregate 20 mm nominal size							
	column footing C1 to C16	16	1.500	1.500	0.300		10.800	
		16	((1.5*1.5)+(.4*.3))/2		0.300		5.688	
	column up to plinth	16	0.300	0.400	1.000		1.920	
	rounded	1	0.592				0.592	
						Total Quantity	19.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	19.000 cum	
						Say 19.000 cum @ Rs 9085.14 / cum	**Rs 172617.66**	
10	5.2.2 Reinforced cement concrete work in walls (any thickness), including attached pilasters, buttresses, plinth and string courses, fillets, columns, pillars, piers, abutments, posts and struts etc. up tot floor five level excluding cost of centering, shuttering, finishing and reinforcement :1:1.5:3(1 cement : 1.5 coarse sand : 3 graded stone aggregate 20 mm nominal size)							

	plinth beam	2	28.300	0.300	0.300		5.094	
	-do- cross	8	5.800	0.300	0.400		5.569	
	column up to beam C1 to C16	16	0.400	0.300	4.000		7.680	
	roof beam long	2	28.300	0.300	0.350		5.943	
	inglind beam	2*8	3.200	0.300	0.350		5.376	
	roof slab	2	29.500	4.5500	0.120		32.214	
	rounded	1	0.124				0.124	
						Total Quantity	62.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	62.000 cum	
						Say 62.000 cum @ Rs 10954.04 / cum	**Rs 679150.48**	
11	5.9.1 Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete							
	Column base	16*4	1.500	0.300			28.800	
	Column up to plinth	16*2	0.400		1.100		14.081	
		16*2	0.300		1.100		10.560	
	rounded	1	0.559				0.559	
						Total Quantity	54.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	54.000 sqm	
						Say 54.000 sqm @ Rs 335.31 / sqm	**Rs 18106.74**	
12	5.9.3 Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform							
	roof slab bottom	2*7	3.700	3.200			165.761	
	side projection	2*2	4.500	0.600			10.800	
	slab projection	2	29.500	1.000			59.000	
	slab projection side	2	29.500	0.120			7.080	
	end side	2*2	4.500	0.120			2.160	
	rounded	1	5.199				5.199	
						Total Quantity	250.000 sqm	
						Total Deducted Quantity	0.000 sqm	

						Net Total Quantity	250.000 sqm	
						Say 250.000 sqm @ Rs 815.78 / sqm	**Rs 203945.00**	
13	5.9.5 Centering and shuttering including strutting, etc. and removal of form for:Lintels, beams, plinth beams, girders bressumers and cantilevers							
	plinth beam out side	2	28.300	0.300			16.980	
	plinth beam in side	2*7	3.700	0.300			15.541	
	cross beam	8*2	5.800	0.400			37.120	
	roof beam out side	2	28.300	0.300			16.980	
	roof beam in side	2*7	3.700	0.400			20.721	
	roof beam bottom	2*7	3.700	0.300			15.541	
	inglind beam side	2*8*2	3.200	0.350			35.840	
	inglind beam bottom	2*8	3.200	0.300			15.360	
	rounded	1	0.917				0.917	
						Total Quantity	175.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	175.000 sqm	
						Say 175.000 sqm @ Rs 649.82 / sqm	**Rs 113718.50**	
14	5.9.6 Centering and shuttering including strutting, etc. and removal of form for:Columns, Pillars, Piers, Abutments, Posts and Struts							
	column C1 to C16	16*2	0.400	4.000			51.200	
		16*2	0.300	4.000			38.400	
	rounded	1	0.400				0.400	
						Total Quantity	90.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	90.000 sqm	
						Say 90.000 sqm @ Rs 863.64 / sqm	**Rs 77727.60**	
15	5.22.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more							
	For column footing	1	16.580			100.0	1658.000	@100kg/ m3
	column up to plinth	1	1.800			120.0	216.000	@120kg/ m3

	rounded	1	6.000				6.000	@120kg/ m3
						Total Quantity	1880.000 kilogram	
						Total Deducted Quantity	0.000 kilogram	
						Net Total Quantity	1880.000 kilogram	
						Say 1880.000 kilogram @ Rs 98.30 / kilogram	**Rs 184804.00**	
16	5.22A.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Thermo - Mechanically Treated bars of grade Fe-500D or more							
	qty vide item No 10 @ 100kg/m3	1	61.876			100.0	6187.600	@100 kg /m3
	rounded	1	12.400				12.400	@100 kg /m3
						Total Quantity	6200.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	6200.000 kg	
						Say 6200.000 kg @ Rs 98.30 / kg	**Rs 609460.00**	
17	7.1.1 Random rubble masonry with hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 (1 cement : 6 coarse sand : 12 graded stone aggregate 20 mm nominal size) up to plinth level with:Cement mortar 1:6 (1 cement : 6 coarse sand)							
	below out side plinth beam	2*7	3.700	0.450	0.600		13.986	
	below cross beam	2	5.800	0.450	0.600		3.132	
	rounded	1	0.882				0.882	
						Total Quantity	18.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	18.000 cum	
						Say 18.000 cum @ Rs 7204.78 / cum	**Rs 129686.04**	
18	2.25 Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.							
	in betwen plinth beams	7	5.700	3.700	0.300		44.290	
	Back filling footing trenches	16	3.000				48.000	

	rounded	1	2.710				2.710	
						Total Quantity	95.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	95.000 cum	
						Say 95.000 cum @ Rs 258.57 / cum	**Rs 24564.15**	
19	13.7.1 12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)							
	For the roof slabs. Top	2	29.500	4.5500			268.450	
	side	2	29.500	0.130			7.670	
	end side	2	9.050	0.130			2.353	
	rounded	1	1.527				1.527	
						Total Quantity	280.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	280.000 sqm	
						Say 280.000 sqm @ Rs 401.21 / sqm	**Rs 112338.80**	
20	13.16.1 6 mm cement plaster of mix:1:3 (1 cement : 3 fine sand)							
	For cross beams side	2*8	6.200	0.350			34.720	
	bottom	8	6.200	0.300			14.880	
	long beam in side	2*7	3.700	0.400			20.721	
	long beam out side	2	28.300	0.300			16.980	
	bottom	2*7	3.700	0.300			15.541	
	slab bottom	2*7	3.700	3.200			165.761	
	roof projection end	2*2	4.500	0.600			10.800	
	out side beam projection side	2	29.500	1.050			61.950	
	column	16	4.000	1.400			89.600	
		1	4.047	1.000			4.047	
						Total Quantity	435.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	435.000 sqm	
						Say 435.000 sqm @ Rs 267.59 / sqm	**Rs 116401.65**	
21	13.4.1							

	12 mm cement plaster of mix:1:4 (1 cement : 4 coarse sand)							
	Auction hall floor	1	28.300	6.400			181.120	
	Rounded	1	3.880				3.880	
						Total Quantity	185.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	185.000 sqm	
						Say 185.000 sqm @ Rs 325.01 / sqm	**Rs 60126.85**	
22	13.43.1 Applying one coat of water thinnable cement primer of approved brand and manufacture on wall surface:Water thinnable cement primer							
	roof beam side & bottom	8	6.200	1.000			49.600	
	long beam out side	2	28.300	0.400			22.640	
	inside	2*7	3.700	0.400			20.721	
	bottom	2*7	3.700	0.300			15.541	
	slab bottom	2*7	3.700	3.200			165.761	
	roff projection end	2*2	4.500	0.600			10.800	
	roff projection side	2	29.500	1.050			61.950	
	column	16	4.000	1.400			89.600	
	side end	2	9.050	0.130			2.353	
	projection side	2	29.500	0.130			7.670	
	top of roof slab	2	29.500	4.550			268.450	
	rounded	1	4.914				4.914	
						Total Quantity	720.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	720.000 sqm	
						Say 720.000 sqm @ Rs 70.64 / sqm	**Rs 50860.80**	
23	13.44.1 Finishing walls with water proofing cement paint of required shade:New work (Two or more coats applied @ 3.84 kg/10 sqm)							
	slab bottom	2*7	3.700	3.200			165.761	
	roof projection end	2*2	4.500	0.600			10.800	
	roof projection side	2	29.500	1.050			61.950	
		1	1.489				1.489	

						Total Quantity	240.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	240.000 sqm	
						Say 240.000 sqm @ Rs 107.39 / sqm	**Rs 25773.60**	
24	13.46.1 Finishing walls with Acrylic Smooth exterior paint of required shade:New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm)							
	roof beam allround	8	6.200	1.000			49.600	
	long beam out side	2	28.300	0.300			16.980	
	long beam in side	2*7	3.700	0.400			20.721	
	bottom	2*7	3.700	0.300			15.541	
	column C1 to C16	16	4.000	1.400			89.600	
	top of roof slab	2	29.500	4.550			268.450	
	side	2	29.500	0.130			7.670	
	side end	2	9.050	0.130			2.353	
		1	4.085				4.085	
						Total Quantity	475.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	475.000 sqm	
						Say 475.000 sqm @ Rs 193.89 / sqm	**Rs 92097.75**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
3 Appendix C- construction of Toilet block								
1	2.8.1 Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil							
	toilet block foundation all round	1	35.500	0.800	0.750		21.300	
	crosswall long	2	11.500	0.800	0.750		13.800	
	cross	1	6.050	0.800	0.750		3.630	
		1	3.150	0.800	0.750		1.891	
	bath room	1	4.800	0.800	0.750		2.880	
	ramp	2	4.500	0.800	0.750		5.400	
	step	1	3.500	1.200	0.600		2.520	

		1	3.000	0.800	0.750		1.801	
	setitank	1	6.700	2.400	2.000		32.160	
	sock pit	1	1.800	1.800	1.500		4.860	
		1	4.758				4.758	
						Total Quantity	95.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	95.000 cum	
						Say 95.000 cum @ Rs 296.94 / cum	**Rs 28209.30**	
2	2.26.1 Extra for every additional lift 1.5 m or part there of in excavation / banking excavated or stacked materials.All kinds of soil							
	tank	1	6.700	2.400	0.500		8.040	
	rounded	1	1.960				1.960	
						Total Quantity	10.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	10.000 cum	
						Say 10.000 cum @ Rs 106.37 / cum	**Rs 1063.70**	
3	4.1.8 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)							
	toilet block foundation all round	1	35.500	0.800	0.150		4.260	
	crosswall long	2	11.500	0.800	0.150		2.761	
	cross	1	6.050	0.800	0.150		0.726	
		1	3.150	0.800	0.150		0.378	
	bath room	1	4.800	0.800	0.150		0.576	
	ramp	2	4.500	0.800	0.150		1.080	
	step	1	3.500	1.200	0.150		0.630	
		1	3.000	0.800	0.150		0.361	
	setitank	1	6.700	2.400	0.200		3.216	
	floor room	1	12.150	4.800	0.100		5.833	
	ramp& varandha	1	13.500	1.200	0.100		1.620	
	rounded	1	0.559				0.559	
						Total Quantity	22.000 cum	

						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	22.000 cum	
						Say 22.000 cum @ Rs 6814.89 / cum	**Rs 149927.58**	
4	7.1.1 Random rubble masonry with hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 (1 cement : 6 coarse sand : 12 graded stone aggregate 20 mm nominal size) up to plinth level with:Cement mortar 1:6 (1 cement : 6 coarse sand)							
	toilet block foundation all round	1	35.500	0.600	0.600		12.780	
	crosswall long	2	11.500	0.600	0.600		8.280	
	cross	1	6.050	0.600	0.600		2.178	
		1	3.150	0.600	0.600		1.134	
	bath room	1	4.800	0.600	0.600		1.728	
	ramp	2	4.500	0.600	0.600		3.240	
	step	1	3.500	1.200	0.450		1.891	
		1	3.000	0.600	0.600		1.080	
	toilet block basement all round	1	35.500	0.450	0.450		7.189	
	crosswall long	2	11.500	0.450	0.450		4.658	
	cross	1	6.050	0.450	0.450		1.226	
		1	3.150	0.450	0.450		0.638	
	bath room	1	4.800	0.450	0.450		0.973	
	ramp	2	3.150	0.450	0.300		0.851	
		1	3.000	0.450	0.450		0.608	
	partition	10	1.500	0.450	0.450		3.038	
	rounded	1	0.508				0.508	
						Total Quantity	52.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	52.000 cum	
						Say 52.000 cum @ Rs 7204.78 / cum	**Rs 374648.56**	
5	2.25 Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.							
	for foundation	1	11.550	3.900	0.600		27.027	

	varandha	1	7.000	0.750	0.600		3.150	
	rounded	1	4.823				4.823	
						Total Quantity	35.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	35.000 cum	
						Say 35.000 cum @ Rs 258.57 / cum	**Rs 9049.95**	
6	5.2.2 Reinforced cement concrete work in walls (any thickness), including attached pilasters, buttresses, plinth and string courses, fillets, columns, pillars, piers, abutments, posts and struts etc. up tot floor five level excluding cost of centering, shuttering, finishing and reinforcement :1:1.5:3(1 cement : 1.5 coarse sand : 3 graded stone aggregate 20 mm nominal size)							
	basement allround	1	35.500	0.450	0.100		1.598	
	cross	1	11.500	0.450	0.100		0.518	
		1	6.050	0.450	0.100		0.273	
		1	3.150	0.450	0.100		0.142	
	bath	1	4.800	0.450	0.100		0.217	
	ramp	1	3.150	0.450	0.100		0.142	
		1	3.000	0.450	0.100		0.135	
	partition	10	1.500	0.450	0.100		0.675	
	lintel	1	76.000	0.150	0.150		1.710	
	roof slab	1	12.750	5.800	0.120		8.874	
	slop	1	39.450	1.000	0.120		4.734	
	tank bottom	1	6.000	2.100	0.150		1.891	
	beam	1	2.100	0.200	0.200		0.085	
	cover slab	1	6.000	2.100	0.120		1.512	
		1	1.800	1.800	0.120		0.389	
	rounded	1	0.105				0.105	
						Total Quantity	23.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	23.000 cum	
						Say 23.000 cum @ Rs 10954.04 / cum	**Rs 251942.92**	
7	5.9.3 Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform							
	basement top	2	35.500	0.100			7.101	

	cross	2	11.500	0.100			2.301	
		2	6.050	0.100			1.210	
		2	3.150	0.100			0.630	
	bath	2	4.800	0.100			0.960	
	ramp	2	6.150	0.100			1.231	
	partition	10*2	1.500	0.100			3.001	
	lintel	2	76.000	0.150			22.800	
	roof slab	1	12.750	5.800			73.950	
	slop	1	39.450	1.000			39.450	
	tank bottom	4	10.200	0.150			6.120	
	beam	1	2.100	0.600			1.260	
	cover slab	12	5.100	0.120			7.344	
		3	4.800	0.120			1.728	
		1	0.914				0.914	
						Total Quantity	170.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	170.000 sqm	
						Say 170.000 sqm @ Rs 815.78 / sqm	**Rs 138682.60**	
8	5.22A.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Thermo - Mechanically Treated bars of grade Fe-500D or more							
	qty of cc	1	22.895			100.0	2289.500	@100kg/ m3
	rounded	1	10.500				10.500	@100kg/ m3
						Total Quantity	2300.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	2300.000 kg	
						Say 2300.000 kg @ Rs 98.30 / kg	**Rs 226090.00**	
9	50.6.2.2 Solid masonry using pre cast solid blocks (factory made) of size 30x20x15cm or nearest available size confirming to IS 2185 part I of 1979 for super structure up to floor two level with thickness 15cm in : CM 1:6 (1 cement : 6 coarse sand) etc complete							
	wall all round	1	34.500	2.800	0.150		14.490	
	cross wal	1	12.150	2.800	0.150		5.103	

	centre cross	1	3.150	2.800	0.150		1.323	
		1	6.050	2.800	0.150		2.541	
	bath	1	4.800	2.800	0.150		2.016	
	septitank	1	16.200	1.800	0.200		5.833	
	step	1	3.000	0.600	0.450		0.810	
	rounded	1	0.593				0.593	
	shutter	1	3.000	2.400	0.150		-1.079	
	door D DA toilet	2	1.000	2.100	0.150		-0.630	
						Total Quantity	32.709 cum	
						Total Deducted Quantity	-1.709 cum	
						Net Total Quantity	31.000 cum	
						Say 31.000 cum @ Rs 6984.85 / cum	**Rs 216530.35**	
10	50.6.3.2 Solid block masonry using pre cast solid blocks (Factory made) of size 40x20x10 cm or nearest available size confirming to IS 2185 part I of 1979 for super structure up to floor two level for 10 cm thick wall in : CM 1:6 (1 cement : 6 coarse sand) including cost of scaffolding complete							
	toilet partition	10	1.500	2.800	0.100		4.200	
	urinal partition	2	1.000	1.400	0.100		0.280	
	parapet	1	37.100	0.600	0.100		2.227	
	seititank partition	2	1.700	1.000	0.100		0.340	
	sock pit	4	1.700	1.200	0.100		0.817	
	rounded	1	0.459				0.459	
	door D1	9	0.700	2.100	0.100		-1.323	
						Total Quantity	8.323 cum	
						Total Deducted Quantity	-1.323 cum	
						Net Total Quantity	7.000 cum	
						Say 7.000 cum @ Rs 7823.61 / cum	**Rs 54765.27**	
11	13.1.1 12 mm cement plaster of mix:1:4 (1 cement : 4 fine sand)							
	out side wall	1	35.300	2.800			98.840	
	Parapet	1	37.100	1.400			51.940	
	toilet inside	10	5.400	2.800			151.200	
	DA toilet	2	6.600	2.800			36.960	
	out side	2	4.800	2.800			26.880	

	bath	1	6.500	2.800			18.200	
	partition	2	3.150	2.800			17.640	
		1	5.300	2.800			14.840	
		1	5.500	2.800			15.400	
		1	3.200	2.800			8.960	
		1	4.850	2.800			13.580	
		1	2.500	2.800			7.000	
	urinal partition	2	2.100	1.500			6.301	
	under side slab	1	12.750	5.800			73.950	
		1	39.450	1.000			39.450	
	rounded	1	5.927				5.927	
	door D	2	1.000	2.100			-4.200	
	toilet door D1	11	0.700	2.100			-16.169	
	ventilator	15	0.600	0.500			-4.500	
	shutter	1	3.000	2.400			-7.199	
						Total Quantity	587.068 sqm	
						Total Deducted Quantity	-32.068 sqm	
						Net Total Quantity	555.000 sqm	
						Say 555.000 sqm @ Rs 314.09 / sqm	**Rs 174319.95**	
12	13.7.1 12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)							
	slab top	1	12.750	5.800			73.950	
		1	39.450	1.000			39.450	
	rounded	1	1.600				1.600	
						Total Quantity	115.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	115.000 sqm	
						Say 115.000 sqm @ Rs 401.21 / sqm	**Rs 46139.15**	
13	13.7.2 12 mm cement plaster finished with a floating coat of neat cement of mix:1:4 (1 cement : 4 fine sand)							
	Septi tank inside	1	15.400	1.800			27.721	
	bottom	1	6.000	1.700			10.200	
	partition wall	2*2	1.700	1.000			6.800	

	roumnded	1	0.279				0.279	
						Total Quantity	45.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	45.000 sqm	
						Say 45.000 sqm @ Rs 386.36 / sqm	**Rs 17386.20**	
14	8.31 Providing and fixing Ist quality ceramic glazed wall tiles conforming to IS: 15622(thickness to be specified by the manufacturer), of approved make, in all colours,shades except burgundy, bottle green, black of any size as approved by Engineerin-Charge,in skirting, risers of steps and dados, over 12 mm thick bed of cementmortar 1:3 (1 cement : 3 coarse sand) and jointing with grey cement slurry @3.3kg per sqm, including pointing in white cement mixed with pigment of matchingshade complete.							
	toilet	11	4.700	1.800			93.060	
	DA toilet	2	5.600	1.800			20.160	
	bath	1	5.800	1.800			10.440	
	urinal portion	3	2.600	1.600			12.480	
	rounded	1	3.860				3.860	
						Total Quantity	140.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	140.000 sqm	
						Say 140.000 sqm @ Rs 1212.78 / sqm	**Rs 169789.20**	
15	11.37 Providing and laying Ceramic glazed floor tiles of size 300x300 mm (thickness to be specified by the manufacturer), of 1st quality conforming to IS : 15622, of approved make, in colours such as White, Ivory, Grey, Fume Red Brown, laid on 20 mm thick cement mortar 1:4 (1 Cement : 4 Coarse sand), including pointing the joints with white cement and matching pigment etc., complete.							
	inside floor	1	12.150	4.800			58.320	
	Rounded	1	1.680				1.680	
						Total Quantity	60.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	60.000 sqm	
						Say 60.000 sqm @ Rs 1091.02 / sqm	**Rs 65461.20**	
16	od206904/2023_2024 :Providing and laying industrial grade antiskid tiles of size 300x300mm with thickness 9mm or nearest with water absorption less than 0.08 % and conforming to I.S. 15622, of approved make, in all colours & shades,laid on 20 mm thick cement mortar 1:4 (1 cement : 4 coarse sand), including grouting the joint with white cement & matching pigments etc. complete.							
	ramp	2	5.200	1.200			12.480	

		1	3.500	1.200			4.200	
	step	3	3.000	0.450			4.051	
	Rounded	1	2.269				2.269	
						Total Quantity	23.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	23.000 sqm	
						Say 23.000 sqm @ Rs 1276.95 / sqm	**Rs 29369.85**	
17	13.43.1 Applying one coat of water thinnable cement primer of approved brand and manufacture on wall surface:Water thinnable cement primer							
	area vide item no 11	1	555.000				555.000	
						Total Quantity	555.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	555.000 sqm	
						Say 555.000 sqm @ Rs 70.64 / sqm	**Rs 39205.20**	
18	13.46.1 Finishing walls with Acrylic Smooth exterior paint of required shade:New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm)							
	out side wall	1	35.300	2.800			98.840	
	Parapet	1	37.100	1.400			51.940	
	rounded	1	4.220				4.220	
						Total Quantity	155.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	155.000 sqm	
						Say 155.000 sqm @ Rs 193.89 / sqm	**Rs 30052.95**	
19	13.83.2 Wall painting with premium acrylic emulsion paint of interior grade, having VOC (Volatile including applying additional coats wherever required to achieve even shade and colour.Two coats							
	toilet inside	10	5.400	1.000			54.000	
	DA toilet	2	6.600	1.000			13.200	
	out	2	4.800	2.800			26.880	
	bath	1	6.500	1.000			6.500	
	partition	2	3.150	2.800			17.640	
		1	5.300	2.800			14.840	
		1	5.500	2.800			15.400	

		1	3.200	2.800			8.960	
		1	4.850	2.800			13.580	
		1	2.500	2.800			7.000	
	urinal partition	2	2.100	1.500			6.301	
	under side slab	1	12.750	5.800			73.950	
		1	39.450	1.000			39.450	
	rounded	1	4.367				4.367	
	door D	2	1.000	2.100			-4.200	
	toilet door	11	0.700	2.100			-16.169	
	ventilator	15	0.600	0.500			-4.500	
	shutter	1	3.000	2.400			-7.199	
						Total Quantity	302.068 sqm	
						Total Deducted Quantity	-32.068 sqm	
						Net Total Quantity	270.000 sqm	
						Say 270.000 sqm @ Rs 134.10 / sqm	**Rs 36207.00**	
20	9.117.1 Providing and fixing factory made uPVC door frame made of uPVC extruded sections having an overall dimension as below (tolerance ±1 mm), with wall thickness 2.0mm (±0.2 mm), corners of the door frame to be jointed with galvanized brackets and stainless steel screws, joints mitred and plastic welded. The hinge side vertical of the frames reinforced by galvanized M.S. tube of size 19 x 19 mm and 1 mm (± 0.1 mm) wall thickness and 3 nos. stainless steel hinges fixed to the frame complete as per manufacturer's specification and direction of Engineer-in-chargeExtruded section profile size 48x40 mm							
	Toilet door 70x210	11	5.600				61.600	
	DA toilet,100x210	2	6.200				12.400	
	rounded	1	1.000				1.000	
						Total Quantity	75.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	75.000 metre	
						Say 75.000 metre @ Rs 260.94 / metre	**Rs 19570.50**	
21	9.118.1 Providing and fixing to existing door frames24 mm thick factory made PVC door shutters made of styles and rails of a uPVC hollow section of size 59x24 mm and wall thickness 2 mm (± 0.2 mm) with inbuilt edging on both sides. The styles and rails mitred and joint at the corners by means of M.S. galvanised/plastic brackets of size 75x220 mm having wall thickness 1.0 mm and stainless steel screws. The styles of the shutter reinforced by inserting galvanised M.S. tube of size 20x20 mm and 1 mm (± 0.1 mm) wall thickness. The lock rail made up of 'H' section, a uPVC hollow section of size 100x24 mm and 2 mm (± 0.2 mm) wall thickness,fixed to the shutter styles by means of plastic/galvanised M.S. 'U' cleats.							

	The shutter frame filled with a uPVC multi-chambered single panel of size not less than 620 mm, having over all thickness of 20 mm and 1 mm (± 0.1 mm) wall thickness. The panels filled vertically and tie bar at two places by inserting horizontally 6 mm galvanised M.S. rod and fastened with nuts and washers, complete as per manufacturer's specification and direction of Engineer-in-charge(For W.C. and bathroom door shutter).							
	Toilet door 70x210	11	0.700	2.100			16.170	
	DA toilet,100x210	2	1.000	2.100			4.200	
	rounded	1	0.630				0.630	
						Total Quantity	21.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	21.000 sqm	
						Say 21.000 sqm @ Rs 2072.49 / sqm	**Rs 43522.29**	
22	9.147B.1 543SUB HEAD : 9 - WOOD & PVC WORK9.147BProviding and fixing factory made uPVC white colour fixed glazed windows/ventilators comprising of uPVC multi-chambered frame and mullion (where everrequired) extruded profiles duly reinforced with 1.60 ± 0.2 mm thick galvanizedmild steel section made from roll forming process of required length (shape &size according to uPVC profile), , uPVC extruded glazing beads of appropriatedimension, EPDM gasket, G.I fasteners 100 x 8 mm size for fixing frame to finishedwall, plastic packers, plastic caps and necessary stainless steel screws etc.Profile of frame shall be mitred cut and fusion welded at all corners, mullion (ifrequired) shall be also fusion welded including drilling of holes for fixinghardware's and drainage of water etc. After fixing frame the gap between frameand adjacent finished wall shall be filled with weather proof silicon sealant overbacker rod of required size and of approved quality, all complete as per approveddrawing & direction of Engineer-in-Charge. (Single / double glass panes andsilicon sealant shall be paid separately). Note: For uPVC frame, sash and mullion extruded profiles minus 5% tolerancein dimension i.e. in depth & width of profile shall be acceptable.Fixed window / ventilator made of (small series) frame 47 x 50 mm & mullion 47x 68 mm both having wall thickness of 1.9 ± 0.2 mm and single glazing bead ofappropriate dimension. (Area upto 0.75 sqm.)							
	for ventilator	15	0.600	0.500			4.500	
						Total Quantity	4.500 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	4.500 sqm	
						Say 4.500 sqm @ Rs 7626.06 / sqm	**Rs 34317.27**	
23	10.3 Providing and fixing in position collapsible steel shutters with vertical channels 20x10x2 mm and braced with flat iron diagonals 20x5 mm size, with top and bottom rail of T-iron 40x40x6 mm, with 40 mm dia steel pulleys, complete with bolts, nuts,locking arrangement, stoppers, handles, including applying a priming coat of approved steel primer .							
	Front shutter	1	3.500	2.400			8.400	

	Rounded	1	0.600				0.600	
						Total Quantity	9.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	9.000 sqm	
						Say 9.000 sqm @ Rs 10205.93 / sqm	**Rs 91853.37**	
24	10.28 Providing and fixing stainless steel (Grade 304) railing made of Hollow tubes, channels, plates etc., including welding, grinding, buffing, polishing and making curvature (wherever required) and fitting the same with necessary stainless steel nuts and bolts complete, i/c fixing the railing with necessary accessories & stainless steel dash fasteners, stainless steel bolts etc., of required size on the top of the floor or the side of waist slab with suitable arrangement as per approval of Engineer-in-charge, (for payment purpose only weight of stainless steel members shall be considered excluding fixing accessories such as nuts, bolts, fasteners etc.)							
	hand rail	2	6.000			20.0	240.000	@20kg/m
						Total Quantity	240.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	240.000 kg	
						Say 240.000 kg @ Rs 677.34 / kg	**Rs 162561.60**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
	4 Appendix D- construction of Parking Area							
1	16.78.1 Construction of granular sub- base by Providing close graded Material conforming to specifications, mixing in a mechanical mix plant at OMC, Carriage of mixed material by tippers to work site, for all leads & lifts, spreading in uniform layers of specified thickness with motor grader on prepared surface and compacting with vibratory power roller to achieve the desired density, complete as per specifications and directions of Engineer-in- Charge.With Material conforming to Grade - I (size range 75 mm to 0.075 mm) having CBR Value- 30							
	Auction hall front	1	40.000	30.000	0.150		180.000	
	side	2	6.000	6.000	0.150		10.800	
	AH west side	1	40.000	15.000	0.150		90.000	
	for road	1	30.000	6.000	0.150		27.000	
	rounded	1	4.200				4.200	
						Total Quantity	312.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	312.000 cum	
						Say 312.000 cum @ Rs 2963.59 / cum	**Rs 924640.08**	
2	16.80							

	Construction of dry lean cement concrete sub base over a prepared sub - grade with coarse and fine aggregate conforming to IS : 383, the size of coarse aggregate not exceeding 25 mm, aggregate cement ration not to exceed 15:1, aggregate gradation after blending to be as per specification, cement content not to be less than 150 Kg/ cum, optimum moisture content to be determined during trial length construction, concrete strength not to be less than 10 Mpa at 7 days, mixed in a batching plant, transported to site, for all leads & lifts, laid with a mechanical paver, compacting with 8-10 tonne vibratory roller, finishing and curing etc. complete as per direction of Engineer-in-charge							
	Auction hall front	1	40.000	30.000	0.150		180.000	
	side	2	6.000	6.000	0.150		10.800	
	AH west side	1	40.000	15.000	0.150		90.000	
	for road	1	30.000	6.000	0.150		27.000	
	rounded	1	4.200				4.200	
						Total Quantity	312.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	312.000 cum	
						Say 312.000 cum @ Rs 4569.25 / cum	**Rs 1425606.00**	
3	16.43.1 Providing and laying design mix cement concrete of M-30 grade, in roads/ taxi tracks/ runways, using cement content as per design mix, using coarse sand and graded stone aggregate of 40 mm nominal size in appropriate proportions as per approved & specified design criteria, providing dowel bars with sleeve/tie bars wherever required, laying at site, spreading and compacting mechanically by using needle and surface vibrators, levelling to required slope/ camber, finishing with required texture, including steel form work with sturdy M.S. channel sections, curing, making provision for contraction / expansion, construction & longitudinal joints (10 mm wide x 50 mm deep) by groove cutting machine, providing and filling joints with approved joint filler and sealants, complete all as per direction of Engineer-in-charge (Item of joint fillers, sealants, dowel bars with sleeve/tie bars to be paid separately). Note: Cement content considered in M-30 is @340 kg/cum. Excess/less cement used as per design mix is payable/ recoverable separately.Cement concrete prepared with batch mixing machine							
	Auction hall front	1	40.000	30.000	0.150		180.000	
	side	2	6.000	6.000	0.150		10.800	
	AH west side	1	40.000	15.000	0.150		90.000	
	for road	1	30.000	6.000	0.150		27.000	
	rounded	1	4.200				4.200	
						Total Quantity	312.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	312.000 cum	
						Say 312.000 cum @ Rs 10302.33 / cum	**Rs 3214326.96**	
4	5.22A.6							

	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Thermo - Mechanically Treated bars of grade Fe-500D or more							
	qty of CC	1	307.800			75.0	23085.000	@75Kg/m3
	rounded	1	15.000				15.000	@75Kg/m3
						Total Quantity	23100.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	23100.000 kg	
						Say 23100.000 kg @ Rs 98.30 / kg	**Rs 2270730.00**	
5	16.44 Extra for providing and mixing hardening compound of approved quality as per manufacturer's specification in cement concrete.							
	qty of cc 307.8*340=104652(2093 bags	1	2093.000			0.2	418.600	@.20 Kg/bag
	Rounded	1	6.400				6.400	@.20 Kg/bag
						Total Quantity	425.000 Litre	
						Total Deducted Quantity	0.000 Litre	
						Net Total Quantity	425.000 Litre	
						Say 425.000 Litre @ Rs 59.86 / Litre	**Rs 25440.50**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
5 Appendix E - Construction of Drain								
1	2.8.1 Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil							
	main drain from Auction hall to sump	1	50.000	1.300	1.000		65.000	
						Total Quantity	65.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	65.000 cum	
						Say 65.000 cum @ Rs 296.94 / cum	**Rs 19301.10**	
2	2.6.1 Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas							

	(exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil							
	Pit of sump	1	8.200	4.000	2.450		80.360	
	soak pit 2m dia	1	3.140	1*1	2.100		6.594	
	round of	1	3.046				3.046	
						Total Quantity	90.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	90.000 cum	
						Say 90.000 cum @ Rs 214.03 / cum	**Rs 19262.70**	
3	4.1.8 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)							
	for drain	1	50.000	1.300	0.150		9.750	
	sump bottom	1	8.200	4.000	0.200		6.560	
	round of	1	0.690				0.690	
						Total Quantity	17.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	17.000 cum	
						Say 17.000 cum @ Rs 6814.89 / cum	**Rs 115853.13**	
4	5.1.2 Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level:1:1:5:3 (1 cement 1.5 coarse sand :3 graded stone aggregate 20 mm nominal size							
	drain bottom slab	1	50.000	1.200	0.100		6.000	
	side wall	2	50.000	1.000	0.200		20.000	
	cover slad for drain 50/.5	100	1.000	0.500	0.150		7.500	
	cover slab sump	16	3.500	0.500	0.120		3.360	
	do beam	1	7.500	0.300	0.300		0.675	
	cover slab soak pit	1	3.140	1.100	0.120		0.415	
	round	1	0.050				0.050	
						Total Quantity	38.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	38.000 cum	

	Say 38.000 cum @ Rs 9085.14 / cum						**Rs 345235.32**	
5	5.9.1 Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete							
	side wall drain out	2	50.000	1.000			100.000	
	side wall drain in	2	50.000	0.900			90.000	
	Total Quantity						190.000 sqm	
	Total Deducted Quantity						0.000 sqm	
	Net Total Quantity						190.000 sqm	
	Say 190.000 sqm @ Rs 335.31 / sqm						**Rs 63708.90**	
6	5.9.5 Centering and shuttering including strutting, etc. and removal of form for:Lintels, beams, plinth beams, girders bressumers and cantilevers							
	For cover slab drain 105 x 50 x 15 cm	100	3.100	0.150			46.500	
	For cover slab Effluent tank sides	16	8.000	0.120			15.360	
	beam	1	7.500	0.900			6.750	
	Rounded	1	1.390				1.390	
	Total Quantity						70.000 sqm	
	Total Deducted Quantity						0.000 sqm	
	Net Total Quantity						70.000 sqm	
	Say 70.000 sqm @ Rs 649.82 / sqm						**Rs 45487.40**	
7	5.22A.1 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Mild steel and Medium Tensile steel bars							
	Qty of CC 38	1	38.000			90.0	3420.000	
	Total Quantity						3420.000 kilogram	
	Total Deducted Quantity						0.000 kilogram	
	Net Total Quantity						3420.000 kilogram	
	Say 3420.000 kilogram @ Rs 96.68 / kilogram						**Rs 330645.60**	
8	50.6.1.1 Solid block masonry using pre cast solid blocks (factory made) of size 40x20x20cm or nearest available size confirming to IS 2185 part 1 of 1979 for foundation and plinth with thickness 20 cm and above in: CM 1:6 (1 cement : 6 coarse sand) etc complete							
	tank side wall	1	21.900	0.200	2.500		10.950	

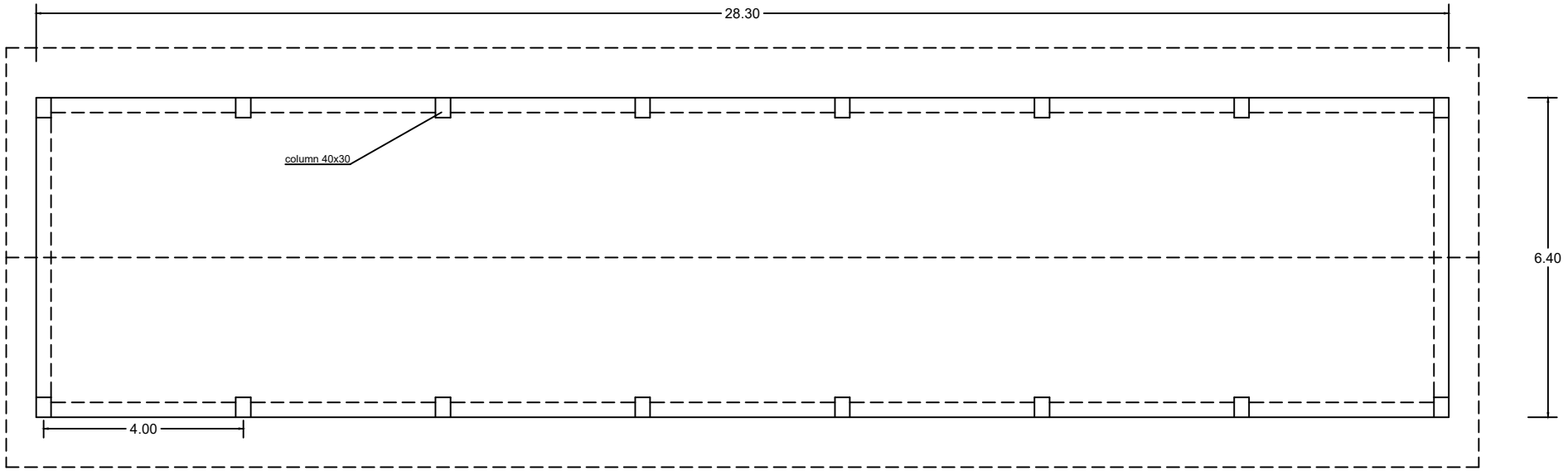
	soak pit 2.00m dia - bottom	1	6.280	0.200	0.300		0.377	
	Rounded	1	0.673				0.673	
						Total Quantity	12.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	12.000 cum	
						Say 12.000 cum @ Rs 5908.32 / cum	**Rs 70899.84**	
9	6.23 Honey-comb brick work 10/11.4 cm thick with common burnt clay bricks of class designation 7.5 in super structure above plinth level upto floor V level with cement mortar 1:4 (1 cement : 4 coarse sand).							
	soak pit 2.00m dia - bottom	1	6.280	1.300			8.165	
	Rounded	1	0.835				0.835	
						Total Quantity	9.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	9.000 sqm	
						Say 9.000 sqm @ Rs 699.37 / sqm	**Rs 6294.33**	
10	13.7.2 12 mm cement plaster finished with a floating coat of neat cement of mix:1:4 (1 cement : 4 fine sand)							
	for Drain side wall - inside	1	50.000	2.600			130.000	
	Effluent tank side wall	2	31.600	2.500			158.000	
	cross wall	2	3.200	2.500			16.000	
	bottom	1	7.600	3.200			24.320	
	Rounded	1	1.680				1.680	
						Total Quantity	330.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	330.000 sqm	
						Say 330.000 sqm @ Rs 386.36 / sqm	**Rs 127498.80**	

Sl No	Description	No	L	B	D	CF	Quantity	Remark
6 Seawall Strengthening								
Lump-Sum Total						**Rs 23600000.00**		

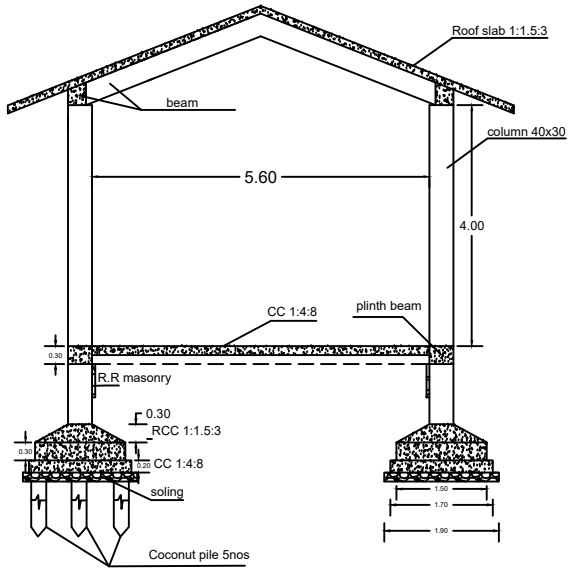
	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**7 Sub soil investigation**							
Lump-Sum Total						**Rs 1500000.00**		

	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**8 Water supply and sanitary arrangement**							
Lump-Sum Total						**Rs 2500000.00**		
	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**9 Electrification and yard lighting**							
Lump-Sum Total						**Rs 1000000.00**		
	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**10 Unforeseen charges @ 2.5%**							
Lump-Sum Total						**Rs 4900000.00**		
	Provision for GST payments (in %) @						**18.0%**	
Amount reserved for GST payments						**35987227.35**		
Total						**235916268.35**		
Lumpsum for round off						**83731.65**		
TOTAL Rs 236000000.00								
Rounded Total Rs 23,60,00,000								
Rupees Twenty Three Crore Sixty Lakh Only								

(Cost Index Applied for this estimate is 35.59%)

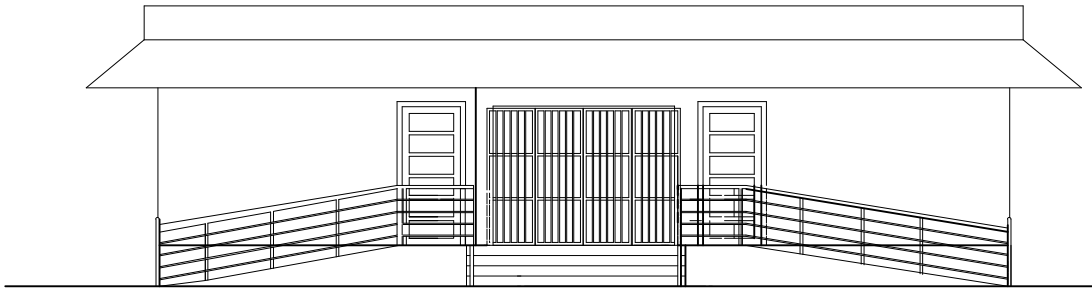


FLC Auction hall plan

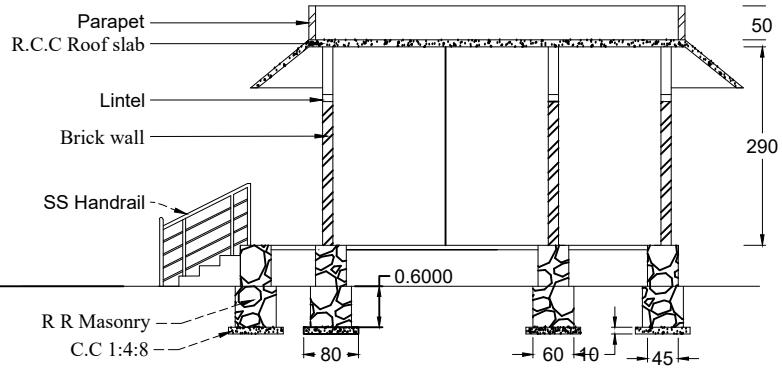


FLC Auction hall cross section

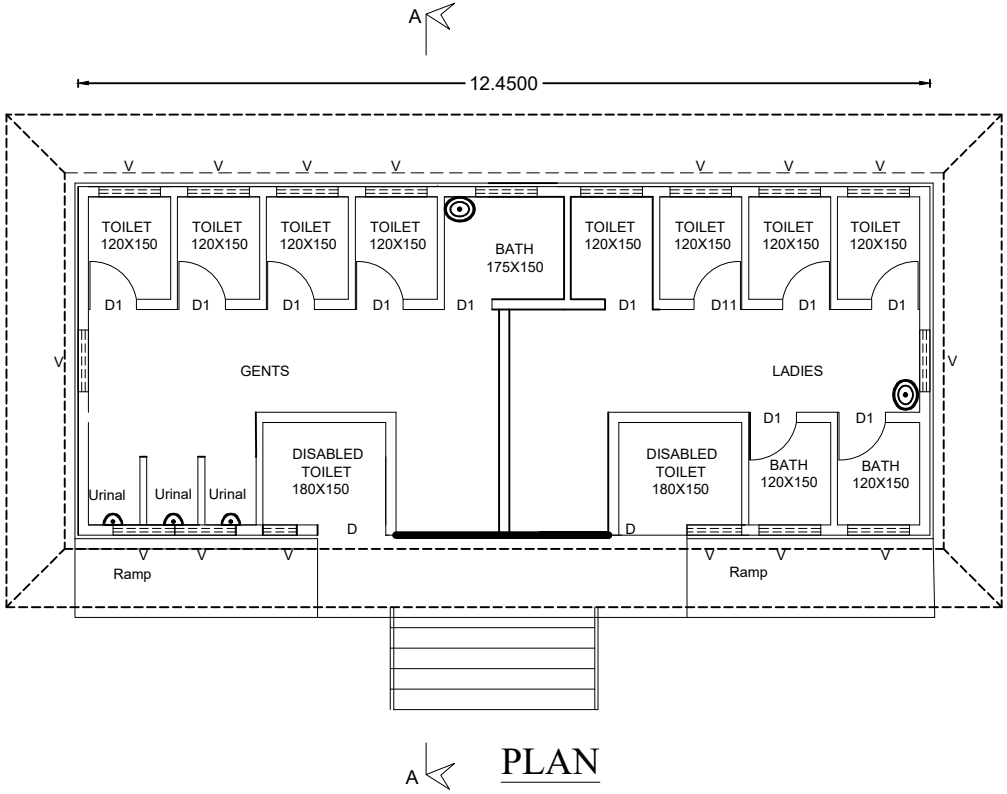
KSCADC	**KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION**	**DEVELOPMENT OF VIPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT PUTHENKADAPPURAM**			
		DRAWING NO:		ASSISTANT ENGINEER:	**ASSISTANT ENGINEER:** SIGNATURE: / **ASSISTANT EXECUTIVE ENGINEER:** SIGNATURE:
		DATE:		DRAWN:	
		TYPE:	**DRAWING**	**REVISION**	**STRUCTURAL CONSULTANT:** DESIGNED & CHECKED BY / **CHIEF ENGINEER:** SIGNATURE:
		TITLE:	FLC AUCTION HALL PLAN & SECTION	1. 2.	



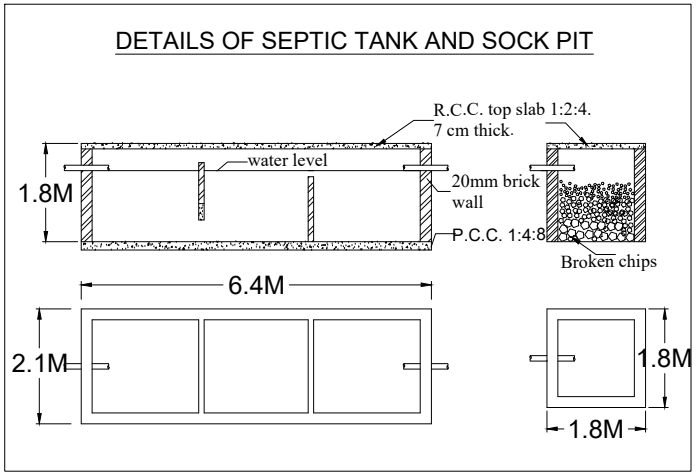
ELEVATION



Section on A A



PLAN

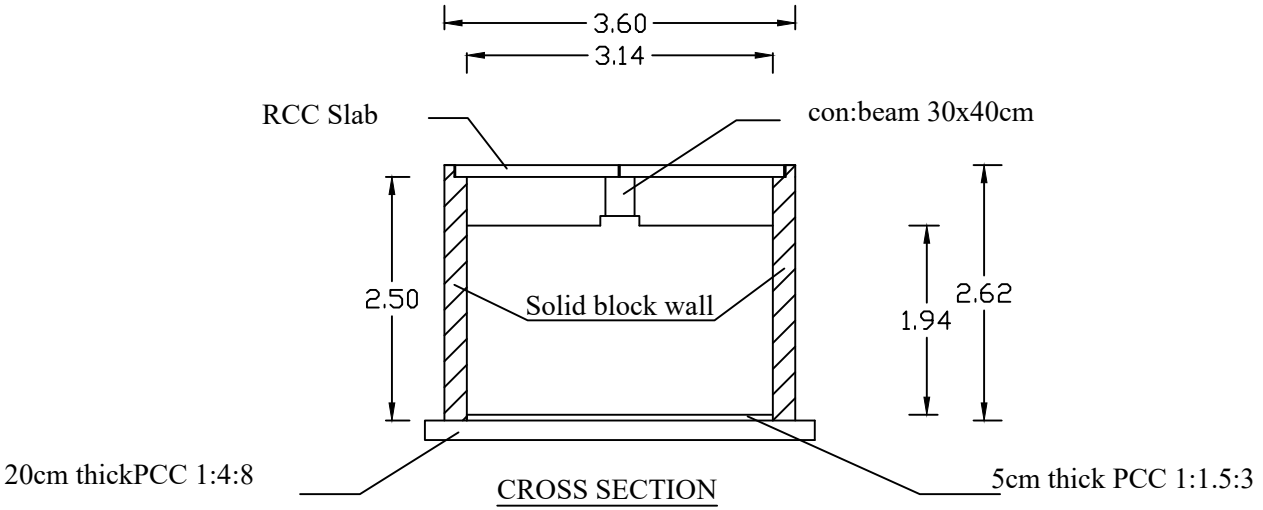


KSCADC

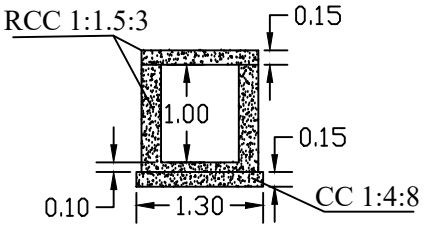
KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION

DEVELOPMENT OF VIPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT PUTHENKADAPPURAM

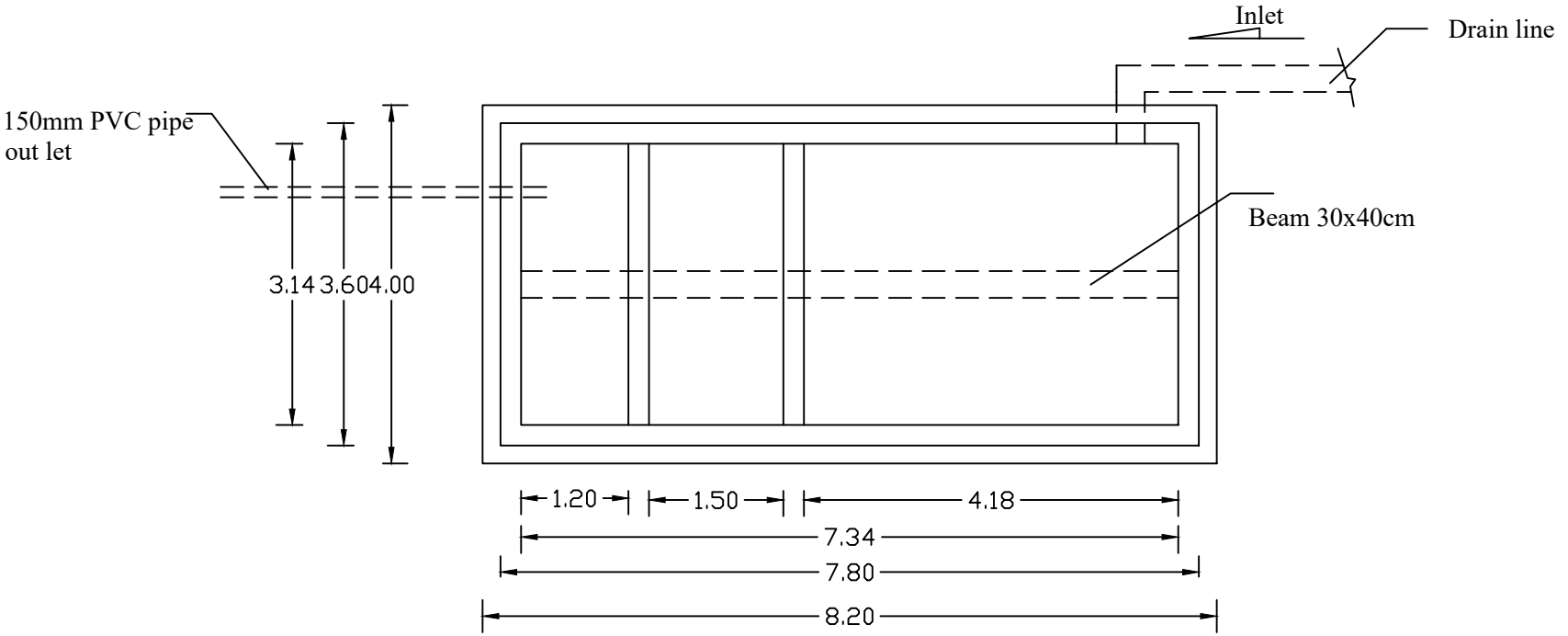
DRAWING NO:		ASSISTANT ENGINEER:		**ASSISTANT ENGINEER:** SIGNATURE:	**ASSISTANT EXECUTIVE ENGINEER:** SIGNATURE:
DATE:		DRAWN:			
TYPE:	**DRAWING**	**REVISION**		**STRUCTURAL CONSULTANT:** DESIGNED & CHECKED BY	**CHIEF ENGINEER:** SIGNATURE:
TITLE:	TOILET BLOCK	1.			
		2.			



CROSS SECTION



Drain Cross section



PLAN

KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION	DEVELOPMENT OF VIPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT PUTHENKADAPPURAM				
	DRAWING NO:		ASSISTANT ENGINEER:		ASSISTANT ENGINEER: SIGNATURE:
	DATE:		DRAWN:		ASSISTANT EXECUTIVE ENGINEER: SIGNATURE:
	TYPE: DRAWING		REVISION		STRUCTURAL CONSULTANT: DESIGNED & CHECKED BY
	TITLE:	FISH LANDING CENTRE DRAIN AND TREATMENT TANK	1. 2.		CHIEF ENGINEER: SIGNATURE:

ANNEXURE 5

Name of work : DEVELOPMENT OF VYPIN - MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION AT PAZHANGADU

ESTIMATE REPORT

Based on the study conducted for shore protection at the Vypin-Munambam stretch by IIT Madras, different types of groynes are proposed for coastal protection at Pazhangadu beach.In this estimate, a series of 2 transitional groynes are proposed. Groynes of lengths 180m and 140m are proposed. A filter layer of 1kg to 10kg category stone, Core layer using 100 to 300 kg stones , Toe Mound using 500 to 800 kg stones , Armour layer using 1.5T to 2.5T stones proposed here. In addition to that, 2T tetrapods of 1.96m Thickness and 4T tetrapods of 2.50m Thickness are provided for armour layer. Lump sum provision for yard lighting is also included in the estimate. Lump sum provision for unforeseen expenses @2.5% are also included in the estimate. Total amount of estimate comes to Rupees 19,70,00,000/-(Rupees Nineteen Crore Seventy Lakh Only) including 18% GST charges but excluding consultancy charges. The estimate is prepared in PRICE based on DSR 2018 and cost index is 35.59%. The provisions adopted in the estimate are adequate for proper completion of work.

DEVELOPMENT OF VYPIN - MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION AT PAZHANGADU

COST ABSTRACT

1	***Groynes***	***Rs.***	***16 18 89 405/-***
2	***Yard lighting***	***Rs.***	***10 00 000/-***
3	***Unforeseen expenses @ 2.5%***	***Rs.***	***40 00 000/-***
4	***Sub Total***	***Rs.***	***16 68 89 405/-***
5	***GST @ 18%***	***Rs.***	***3 00 40 093/-***
6	***Total Amount including GST 18%***	***Rs.***	***19 69 29 498/-***
7	***Lumpsum for Round off***	***Rs.***	***70 502/-***
8	***Total Amount***	***Rs.***	***19 70 00 000/-***
9	***Consultancy @5%***	***Rs.***	***98 50 000/-***
10	***GST on consultancy @ 18%***	***Rs.***	***17 73 000/-***
11	***Round off***	***Rs.***	***77 000/-***
12	***Grand Total***	***Rs.***	***20 87 00 000/-***

Rupees Twenty Crore Eighty Seven Lakh Only

DEVELOPMENT OF VYPIN - MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION AT PAZHANGADU

General Abstract

(Dsor year: **2018**,Cost Index Applied for this estimate is **35.59**%)

Sl No	Heading Description	Amount
1	**GROYNES**	161889405.28
2	**Yard lighting**	1000000.00
3	**Unforeseen expenses @ 2.5%**	4000000.00
	Provision for GST payments (in %) @	**18.0%**
	Amount reserved for GST payments	**30040092.95**
	Total	**196929497.95**
	Lumpsum for round off	**70502.05**
		TOTAL Rs 197000000.00
		Rounded Total Rs 19,70,00,000
		Rupees Nineteen Crore Seventy Lakh Only

(Cost Index Applied for this estimate is 35.59%)

DEVELOPMENT OF VYPIN - MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION AT PAZHANGADU

Detailed Estimate

(Dsor year: **2018**,Cost Index Applied for this estimate is **35.59**%)

Sl No	Description	No	L	B	D	CF	Quantity	Remark
	1 GROYNES							
1	od207061/2023_2024 Moulding and supplying cement concrete 1.6m3 (4T) tetrapod with graded aggregate of 40% 75mm to 40 mm, 30% 40 to 20mm, 30% 20 to 5mm using 380 kg cement /m3 pf cpmcrete as per approved mix design of mix proportion 0.5:,1.46:3.22 by weight of water cement, fine aggregate, course aggregate (specific gravity of fine aggregate and course aggregateshould not be less than 2.73 and 2.5 respectively) and the cement shall be 43 grade or higher) minimum cube strength requirement (i) @ 7 day - 20N/mm2 (ii) @ 28 day - 30N/mm2 and minimum density of concrete 2.5 g/cc. including hire and operational charge of tools and plants moulding and rehandling and stacking charge etc complete according to specification and instructions of Engineer							
	ARMOUR LAYER, 4T tetrapods at 2.50m Thick	3200					3200.000	
	Total Quantity						3200.000 each	
	Total Deducted Quantity						0.000 each	
	Net Total Quantity						3200.000 each	
	Say 3200.000 each @ Rs 15999.39 / each						**Rs 51198048.00**	
2	od207063/2023_2024 Conveying 1.6m3 (4T) tetrapods from stacking and placing in two layer according to specification and forming the armour layer of break water to lines and levels at depth of water 8m and above including hire and operational charges of tools and plants etc complete							
	ARMOUR LAYER, 4T tetrapods at 2.50m Thick	3200					3200.000	
	Total Quantity						3200.000 each	
	Total Deducted Quantity						0.000 each	
	Net Total Quantity						3200.000 each	
	Say 3200.000 each @ Rs 2042.97 / each						**Rs 6537504.00**	
3	65.103 Moulding and supplying 0.8 cum(2T) tetrapod with graded aggregate of 40% 75mm to 40mm, 30% 40mm to 20mm and 30% 20mm to 6mm using 380kg cement/ m3 of concrete as per approved mix design of mix proportion 0.5:1:1. 46:3.22 by weight of water cement, fine aggregate, coarse aggregate (specific gravity of fine aggregate and coarse aggregate should not be less than 2.73 and 2.5 respectively) and the cement shall be 43 grade or higher) minimum cube strength requirement (i) @7 day - 20 N/mm2 (ii) @ 28 day - 30 N/mm2 and minimum density of concrete 2.5 g/cc including hire and operational charges of tools							

	and plants, mould, curing, rehandling and stacking charges etc., complete as per the instruction of departmental officers at site .							
	ARMOUR LAYER, 2T tetrapods at 1.96m Thick	2080					2080.000	
						Total Quantity	2080.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	2080.000 each	
						Say 2080.000 each @ Rs 7596.47 / each	**Rs 15800657.60**	
4	65.104 Conveying 0.8cum (2T) tetrapod from stacking yard and placing in position in two layers according to specification and forming the armour layer of breakwater to lines and levels over the secondary armour layer including hire and operational charges of tools and plants etc., complete as per the direction of the departmental officers at site							
	ARMOUR LAYER, 2T tetrapods at 1.96m Thick	2080					2080.000	
						Total Quantity	2080.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	2080.000 each	
						Say 2080.000 each @ Rs 912.92 / each	**Rs 1898873.60**	
5	2.6.1 Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil							
	From Chainage 0 to 40m	2	40.000	35.000	2.000		5600.000	
						Total Quantity	5600.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	5600.000 cum	
						Say 5600.000 cum @ Rs 214.03 / cum	**Rs 1198568.00**	
6	od207067/2023_2024 Supplying and laying Geotextile 120 gram per sqm membrane (best quality) including providing necessary overlaps, all cost, conveyance, labour charges etc complete as per the instruction of departmental officers at site.							
	Geotextile Layer							

	Northern Groyne 180m Chainage 0 to 180	1	180.000	40.000			7200.000	
	Southern Groyne 140m							
	Chainage 0 to 140m	1	140.000	40.000			5600.000	
						Total Quantity	12800.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	12800.000 sqm	
						Say 12800.000 sqm @ Rs 83.20 / sqm	**Rs 1064960.00**	
7	od207068/2023_2024 [Based on 65.32]Supplying blasted rock from approved quarry to sorting site and sorting the stones into 1.5T to 2.5T(70% of stones > 2.0T) category stones of approved quality having specific gravity ranges from 2.65 to 2.8 for forming the primary armour and berm of rubble mount breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and the measurements of catagorised stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater and forming the primary armour of the breakwater to the lines and levels as per approved drawings with tolerance of +/- 20 cm in final levels including all cost and labour charges, hire and operational charges of mobile crane and excavator, rehandling, placing and packing and using mobile crane, inspecting the profile once in a week and cost of spalls/quarry muck and hire of machineries for forming the roadway for movement of lorries/tippers/cranes etc including all incidental charges etc complete as per the direction of departmental officers at site Ernakulam District								
	Armour layer using 1.5T to 2.5T stones (Assuming 1/3 void and sp.gravity 2.7)							
	Northern Groyne 180m Chainage 0 to 180m	1	4521.150				4521.150	
	Southern Groyne 140m							
	Chainage 0 to 140m	1	3956.010				3956.010	
						Total Quantity	8477.160 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	8477.160 tonne	
						Say 8477.160 tonne @ Rs 1781.12 / tonne	**Rs 15098839.22**	
8	od207069/2023_2024 Supplying blasted rock from approved quarry to sorting site and sorting the stones into 500kg to 800kg category stones of approved quality having specific gravity ranges from 2.65 to 2.8 for forming the primary armour and berm of rubble mount breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and the measurements of catagorised stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and							

	conveyed to the approved alignment of the breakwater and forming the primary armour of the breakwater to the lines and levels as per approved drawings with tolerance of +/- 20 cm in final levels including all cost and labour charges, hire and operational charges of mobile crane and excavator, rehandling, placing and packing and using mobile crane, inspecting the profile once in a week and cost of spalls/quarry muck and hire of machineries for forming the roadway for movement of lorries/tippers/cranes etc including all incidental charges etc complete as per the direction of departmental officers at site Ernakulam District							
	Toe Mound using 500 to 800 kg stones (Assuming 1/3 void and sp.gravity 2.7)							
	Northern Groyne 180m Chainage 0 to 180m	1	8327.250		1.050		8743.613	5% sinkage added
	Head	1	737.650		1.050		774.533	5% sinkage added
	Southern Groyne 140m							
	Chainage 0 to 140m	1	5899.520		1.050		6194.497	
	Head	1	485.070		1.050		509.324	
	Total Quantity						16221.967 tonne	
	Total Deducted Quantity						0.000 tonne	
	Net Total Quantity						16221.967 tonne	
	Say 16221.967 tonne @ Rs 1781.12 / tonne						**Rs 28893269.86**	
9	od208842/2023_2024 [Based on 65.30]Supplying granite blasted rock from approved quarry to sorting site by lorry/ tipper, and sorting the stones into 100kg to 300kg category stones of approved quality having specific gravity ranging from 2.65 to 2.8 for forming the core of rubble mound breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and measurements of categorized stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater and rehandling and forming the core of the break water to the lines and levels as per the approved drawings and inspecting the profile once in a week with tolerance of +/- 20cm in final levels including all cost and labour charges, hire and operational charges of light crane and cost of spalls/ quarry muck and labour for forming the roadway for movement of lorries/ tippers / cranes etc including all incidental charges etc complete as per the direction of departmental officers at site Ernakulam District							
	Core layer using 100 to 300 kg stones (Assuming 1/3 void and sp.gravity 2.7)							
	Northern Groyne 180m Chainage 0 to 180m	1	9578.210		1.100		10536.031	10% sinkage added

	Head	1	387.010		1.100		425.711	10% sinkage added
	Southern Groyne 140m							
	Chainage 0 to 140m	1	7078.240		1.100		7786.064	
	Head	1	314.970		1.100		346.468	
						Total Quantity	19094.274 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	19094.274 tonne	
						Say 19094.274 tonne @ Rs 1610.75 / tonne	**Rs 30756101.85**	
10	od208843/2023_2024 Supplying granite quarry run from approved quarry to sorting site by lorry/ tipper, and sorting the stones into 1 kg to 10 kg category stones of approved quality with specific gravity ranging from 2.65 to 2.8 for forming the filter layer of breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and the measurements of categorized stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater including conveyance from sorting platform and dumping stones using tippler (3.5x2.5 sqm size) or any suitable methods installed at site on a moving crane having a capaciaty of not less than 20T and placing the stones at sea bed in uniform layer of design thickness for forming filter layer of breakwater as per the approved drawing and design and inspecting the profile once in a week including hire and operational charges of T & P, tippler, crane and all incidental charges etc. complete as per the direction of departmental officers at site. Eranakulam District								
	Filter layer using 1 to 10 kg stones (Assuming 1/3 void and sp.gravity 2.7)							
	Northern Groyne 180m Chainage 0 to 180m	1	2942.080				2942.080	
	Head	1	305.420				305.420	
	Southern Groyne 140m							
	Chainage 0 to 140m	1	2227.510				2227.510	
	Head	1	281.750				281.750	
						Total Quantity	5756.760 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	5756.760 tonne	
						Say 5756.760 tonne @ Rs 1640.26 / tonne	**Rs 9442583.16**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
2 Yard lighting								
Lump-Sum Total							**Rs 1000000.00**	

	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**3 Unforeseen expenses @ 2.5%**							
Lump-Sum Total						**Rs 4000000.00**		
	Provision for GST payments (in %) @						**18.0%**	
Amount reserved for GST payments						**30040092.95**		
Total						**196929497.95**		
Lumpsum for round off						**70502.05**		
TOTAL Rs 197000000.00								
Rounded Total Rs 19,70,00,000								
Rupees Nineteen Crore Seventy Lakh Only								

(Cost Index Applied for this estimate is 35.59%)

ANNEXURE 6

Name of work : DEVELOPMENT OF VYPIN - MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION AND CONSTRACTION OF FISH LANDING CENTRE AT SAIDH MOHAMMED BEACH

ESTIMATE REPORT

The estimate for the construction of Fish Landing Centre at Saidh Mohammed Beach is prepared based on the study conducted by IIT Madras for the coastal protection from Vypin to Munambam stretch wherein different types of groynes are proposed for coastal protection.This stretch of the coastline is identified as a fishing landing centre and it is already protected with seawall and groynes. A proposal is made to extend the existing groynes for about 160 m in length and construct a pair of groynes to form a fish landing centre . In this estimate, a series of 2 transitional groynes are proposed. Accordingly, groynes of length 160m and 120m are proposed. A filter layer of 1kg to 10kg category stone, Core layer using 100 to 300 kg stones , Toe Mound using 500 to 800 kg stones , Armour layer using 1.5T to 2.5T stones proposed here. In addition to that 2T tetrapods at 1.96m Thick and 4T tetrapods at 2.50m Thick is provided for armour layer. 2Provision for Auction hall building of size 28.3m x 6.4m is included in the estimate. For the auction hall, coconut piling of length 6m long is provided for foundation. RCC M20 provided for foundations, centering & shuttering, Reinforcement cement concrete work (M20) in walls is provided for super structure. Necessary Steel reinforcement, plastering and painting works are also included in the Auction hall. Provision for construction of a toilet block of size 12.5m x 5.1m is also included in the estimate. For the toilet block, RR masonry with cement mortar 1:6 is provided for the foundation.Solid block masonry of size 30x20x15cm and 40x20x10 cm are provided for super structure. Ceramic tiling is provided in the floor and in the bathroom region. Necessary fittings are also provided for toilet block. Other provisions in the estimateinclude concrete parking area proposed near the the Auction hall. Provision for the construction of drain is also included in the estimate. Total amount of estimate comes to Rupees 23,60,00000/-(Twenty Three crore Sixty lakh) including 18% GST charges but excluding consultancy charges. The estimate is prepared in PRICE based on DSR 2018 and cost index is 35.59%. The provisions adopted in the estimate are adequate for proper completion of work

DEVELOPMENT OF VYPIN - MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION AND CONSTRACTION OF FISH LANDING CENTRE AT SAIDH MOHAMMED BEACH

COST ABSTRACT

1	*APPENDIX - A GROYNE*	*Rs.*	*14 11 98 972/-*
2	*APPENDIX B- CONSTRUCTION OF AUCTION HALL*	*Rs.*	*31 90 663/-*
3	*Appendix C- construction of Toilet block*	*Rs.*	*24 10 666/-*
4	*Appendix D- construction of Parking Area*	*Rs.*	*78 60 744/-*
5	*Appendix E - Construction of Drain*	*Rs.*	*11 44 187/-*
6	*Seawall Strengthening*	*Rs.*	*3 25 00 000/-*
7	*Sub soil investigation*	*Rs.*	*19 00 000/-*
8	*Water supply and sanitary arrangement*	*Rs.*	*25 00 000/-*
9	*Electrification and yard lighting*	*Rs.*	*23 00 000/-*
10	*Unforeseen expenses @ 2.5%*	*Rs.*	*49 50 000/-*
11	*Sub Total*	*Rs.*	*19 99 55 232/-*
12	*GST @ 18%*	*Rs.*	*3 59 91 942/-*
13	*Total Amount including GST 18%*	*Rs.*	*23 59 47 174/-*
14	*Lumpsum for Round off*	*Rs.*	*52 826/-*
15	*Total Amount*	*Rs.*	*23 60 00 000/-*
16	*Consultancy @5%*	*Rs.*	*1 18 00 000/-*
17	*GST on consultancy @ 18%*	*Rs.*	*21 24 000/-*
18	*Round off*	*Rs.*	*76 000/-*
19	*Grand Total*	*Rs.*	*25 00 00 000/-*

Rupees Twenty Five Crore Only

DEVELOPMENT OF VYPIN - MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION AND CONSTRACTION OF FISH LANDING CENTRE AT SAIDH MOHAMMED BEACH

General Abstract

(Dsor year: **2018**,Cost Index Applied for this estimate is **35.59**%)

Sl No	Heading Description	Amount
1	**APPENDIX A- GROYNE**	141198972.13
2	**APPENDIX B CONSTRUCTION OF AUCTION HALL**	3190663.46
3	**Appendix C- construction of Toilet block**	2410665.96
4	**Appendix D- construction of Parking Area**	7860743.54
5	**Appendix E - Construction of Drain**	1144187.11
6	**Seawall Strengthening**	32500000.00
7	**Sub soil investigation**	1900000.00
8	**Water supply and sanitary arrangement**	2500000.00
9	**Electrification and yard lighting**	2300000.00
10	**Unforeseen charges @ 2.5%**	4950000.00
	Provision for GST payments (in %) @	**18.0%**
	Amount reserved for GST payments	**35991941.80**
	Total	**235947173.80**
	Lumpsum for round off	**52826.20**
		TOTAL Rs 236000000.00
		Rounded Total Rs 23,60,00,000
		Rupees Twenty Three Crore Sixty Lakh Only

(Cost Index Applied for this estimate is 35.59%)

DEVELOPMENT OF VYPIN - MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION AND CONSTRACTION OF FISH LANDING CENTRE AT SAIDH MOHAMMED BEACH

Detailed Estimate

(Dsor year: **2018**,Cost Index Applied for this estimate is **35.59**%)

Sl No	Description	No	L	B	D	CF	Quantity	Remark
	1 APPENDIX A- GROYNE							
1	od207101/2023_2024 Moulding and supplying cement concrete 1.6m3 (4T) tetrapod with graded aggregate of 40% 75mm to 40 mm, 30% 40 to 20mm, 30% 20 to 5mm using 380 kg cement /m3 pf cpmcrete as per approved mix design of mix proportion 0.5:,1.46:3.22 by weight of water cement, fine aggregate, course aggregate (specific gravity of fine aggregate and course aggregateshould not be less than 2.73 and 2.5 respectively) and the cement shall be 43 grade or higher) minimum cube strength requirement (i) @ 7 day - 20N/mm2 (ii) @ 28 day - 30N/mm2 and minimum density of concrete 2.5 g/cc. including hire and operational charge of tools and plants moulding and rehandling and stacking charge etc complete according to specification and instructions of Engineer							
	ARMOUR LAYER, 4T tetrapods at 2.50m Thick	2960					2960.000	
						Total Quantity	2960.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	2960.000 each	
						Say 2960.000 each @ Rs 15999.39 / each	**Rs 47358194.40**	
2	od207103/2023_2024 Conveying 1.6m3 (4T) tetrapods from stacking and placing in two layer according to specification and forming the armour layer of break water to lines and levels at depth of water 8m and above including hire and operational charges of tools and plants etc complete							
	ARMOUR LAYER, 4T tetrapods at 2.50m Thick	2960					2960.000	
						Total Quantity	2960.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	2960.000 each	
						Say 2960.000 each @ Rs 2042.97 / each	**Rs 6047191.20**	
3	65.103 Moulding and supplying 0.8 cum(2T) tetrapod with graded aggregate of 40% 75mm to 40mm, 30% 40mm to 20mm and 30% 20mm to 6mm using 380kg cement/ m3 of concrete as per approved mix design of mix proportion 0.5:1:1. 46:3.22 by weight of water cement, fine aggregate, coarse aggregate (specific gravity of fine aggregate and coarse aggregate should not be less than 2.73 and 2.5 respectively) and the cement shall be 43 grade or higher) minimum cube strength requirement (i) @7 day - 20 N/mm2 (ii) @ 28							

	day - 30 N/mm2 and minimum density of concrete 2.5 g/cc including hire and operational charges of tools and plants, mould, curing, rehandling and stacking charges etc., complete as per the instruction of departmental officers at site .							
	ARMOUR LAYER, 2T tetrapods at 1.96m Thick	2080					2080.000	
						Total Quantity	2080.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	2080.000 each	
						Say 2080.000 each @ Rs 7596.47 / each	**Rs 15800657.60**	
4	65.104 Conveying 0.8cum (2T) tetrapod from stacking yard and placing in position in two layers according to specification and forming the armour layer of breakwater to lines and levels over the secondary armour layer including hire and operational charges of tools and plants etc., complete as per the direction of the departmental officers at site							
	ARMOUR LAYER, 2T tetrapods at 1.96m Thick	2080					2080.000	
						Total Quantity	2080.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	2080.000 each	
						Say 2080.000 each @ Rs 912.92 / each	**Rs 1898873.60**	
5	2.6.1 Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil							
	From Chainage 0 to 40m	2	40.000	35.000	2.000		5600.000	
						Total Quantity	5600.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	5600.000 cum	
						Say 5600.000 cum @ Rs 214.03 / cum	**Rs 1198568.00**	
6	od207107/2023_2024 Supplying and laying Geotextile 120 gram per sqm membrane (best quality) including providing necessary overlaps, all cost, conveyance, labour charges etc complete as per the instruction of departmental officers at site.							
	Geotextile Layer							

	Northern Groyne 160m Chainage 0 to 160m	1	160.000	40.000			6400.000	
	Southern Groyne 170m							
	Chainage 0 to 120m	1	120.000	40.000			4800.000	
						Total Quantity	11200.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	11200.000 sqm	
						Say 11200.000 sqm @ Rs 83.20 / sqm	**Rs 931840.00**	
7	od207108/2023_2024 [Based on 65.32]Supplying blasted rock from approved quarry to sorting site and sorting the stones into 1.5T to 2.5T(70% of stones > 2.0T) category stones of approved quality having specific gravity ranges from 2.65 to 2.8 for forming the primary armour and berm of rubble mount breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and the measurements of catagorised stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater and forming the primary armour of the breakwater to the lines and levels as per approved drawings with tolerance of +/- 20 cm in final levels including all cost and labour charges, hire and operational charges of mobile crane and excavator, rehandling, placing and packing and using mobile crane, inspecting the profile once in a week and cost of spalls/quarry muck and hire of machineries for forming the roadway for movement of lorries/tippers/cranes etc including all incidental charges etc complete as per the direction of departmental officers at site Ernakulam District							
	Armour layer using 1.5T to 2.5T stones (Assuming 1/3 void and sp.gravity 2.7)							
	Northern Groyne 160m Chainage 0 to 160m	1	4521.150				4521.150	
	Southern Groyne 120m							
	Chainage 0 to 120m	1	3876.890				3876.890	
						Total Quantity	8398.040 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	8398.040 tonne	
						Say 8398.040 tonne @ Rs 1781.12 / tonne	**Rs 14957917.00**	
8	od207109/2023_2024 Supplying blasted rock from approved quarry to sorting site and sorting the stones into 500kg to 800kg category stones of approved quality having specific gravity ranges from 2.65 to 2.8 for forming the primary armour and berm of rubble mount breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and the measurements of catagorised stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and							

	conveyed to the approved alignment of the breakwater and forming the primary armour of the breakwater to the lines and levels as per approved drawings with tolerance of +/- 20 cm in final levels including all cost and labour charges, hire and operational charges of mobile crane and excavator, rehandling, placing and packing and using mobile crane, inspecting the profile once in a week and cost of spalls/quarry muck and hire of machineries for forming the roadway for movement of lorries/tippers/cranes etc including all incidental charges etc complete as per the direction of departmental officers at site Ernakulam District							
	Toe Mound using 500 to 800 kg stones (Assuming 1/3 void and sp.gravity 2.7)							
	Northern Groyne 160m Chainage 0 to 160m	1	6742.310		1.050		7079.426	5% sinkage added
	Southern Groyne 120m							
	Chainage 0 to 120m	1	4492.020		1.050		4716.622	
						Total Quantity	11796.048 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	11796.048 tonne	
						Say 11796.048 tonne @ Rs 1781.12 / tonne	**Rs 21010177.01**	
9	od208628/2023_2024 [Based on 65.30]Supplying granite blasted rock from approved quarry to sorting site by lorry/ tipper, and sorting the stones into 100kg to 300kg category stones of approved quality having specific gravity ranging from 2.65 to 2.8 for forming the core of rubble mound breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and measurements of categorized stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater and rehandling and forming the core of the break water to the lines and levels as per the approved drawings and inspecting the profile once in a week with tolerance of +/- 20cm in final levels including all cost and labour charges, hire and operational charges of light crane and cost of spalls/ quarry muck and labour for forming the roadway for movement of lorries/ tippers / cranes etc including all incidental charges etc complete as per the direction of departmental officers at site Ernakulam District							
	Core layer using 100 to 300 kg stones (Assuming 1/3 void and sp.gravity 2.7)							
	Northern Groyne 160m Chainage 0 to 160m	1	8089.420		1.100		8898.363	10% sinkage added
	Southern Groyne 120m							
	Chainage 0 to 120m	1	5892.770		1.100		6482.048	
						Total Quantity	15380.411 tonne	
						Total Deducted Quantity	0.000 tonne	
						Net Total Quantity	15380.411 tonne	

	Say 15380.411 tonne @ Rs 1610.75 / tonne						**Rs 24773997.02**	
10	od208768/2023_2024 Supplying granite quarry run from approved quarry to sorting site by lorry/ tipper, and sorting the stones into 1 kg to 10 kg category stones of approved quality with specific gravity ranging from 2.65 to 2.8 for forming the filter layer of breakwater inclusive of cost of stones, hire of lorries and machineries, labour charges required at quarry and at sorting place and the measurements of categorized stones after proper sorting are taken on weigh bridge installed at site at the cost of the contractor with approved software having printouts using contractors supplied papers, stationeries and conveyed to the approved alignment of the breakwater including conveyance from sorting platform and dumping stones using tippler (3.5x2.5 sqm size) or any suitable methods installed at site on a moving crane having a capaciaty of not less than 20T and placing the stones at sea bed in uniform layer of design thickness for forming filter layer of breakwater as per the approved drawing and design and inspecting the profile once in a week including hire and operational charges of T & P, tippler, crane and all incidental charges etc. complete as per the direction of departmental officers at site. Eranakulam District							
	Filter layer using 1 to 10 kg stones (Assuming 1/3 void and sp.gravity 2.7)							
	Northern Groyne 160m Chainage 0 to 160m	1	2545.720				2545.720	
	Southern Groyne 120m							
	Chainage 0 to 120m	1	1856.970				1856.970	
	Total Quantity						4402.690 tonne	
	Total Deducted Quantity						0.000 tonne	
	Net Total Quantity						4402.690 tonne	
	Say 4402.690 tonne @ Rs 1640.26 / tonne						**Rs 7221556.30**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
2 APPENDIX B CONSTRUCTION OF AUCTION HALL								
1	2.8.1 Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil							
	column footing	16	2.100	2.100	1.900		134.064	
	below out side plinth beam	2*7	3.700	0.450	0.600		13.986	
	cross beam	2	5.800	0.450	0.600		3.132	
	rounded	1	3.818				3.818	
	Total Quantity						155.000 cum	
	Total Deducted Quantity						0.000 cum	
	Net Total Quantity						155.000 cum	

						Say 155.000 cum @ Rs 296.94 / cum	**Rs 46025.70**	
2	od207102/2023_2024 Supplying and stacking good quality coconut piles							
	For pile 16 x5 Nos =80 Nos	80	6.000				480.000	
						Total Quantity	480.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	480.000 metre	
						Say 480.000 metre @ Rs 107.64 / metre	**Rs 51667.20**	
3	od207104/2023_2024 Coconut Pile- Driving down coconut pile to lines and levels through soft to medium clay soil strata including all hire charges and labour for fixing, staging platform and all other appliances necessary for pile driving down after pointing the bottom end. Details of one post of 6m long 15 numbers per day 6x15=90m.							
	For coconut pile	80	6.000				480.000	
						Total Quantity	480.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	480.000 metre	
						Say 480.000 metre @ Rs 216.92 / metre	**Rs 104121.60**	
4	od207105/2023_2024 Cutting and removing the excess length of wooden piles to lines and levels and removing the cut end of piles and stacking within 150m							
	excess length of pile	16	1.000				16.000	
						Total Quantity	16.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	16.000 metre	
						Say 16.000 metre @ Rs 154.21 / metre	**Rs 2467.36**	
5	2.18.1 Close timbering over areas including strutting, shoring and packing cavities (wherever required) etc. complete (Measurements to be taken of the face area timbered):Depth not exceeding 1.5 m							
	column excavation side	16*4	2.000	1.200			153.600	
	rounded	1	1.400				1.400	
						Total Quantity	155.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	155.000 sqm	

							Say 155.000 sqm @ Rs 136.88 / sqm	**Rs 21216.40**
6	od207106/2023_2024 Providing and laying filter media with granular crushed aggregates as per specification to a thickness of not less than 600 mm with smaller size towards the soil and bigger size towards the wall and providing over the entire surface behind abutment, wing wall, return wall to the full height, compacted to firm condition complete as per drawing and technical specification Clause 1204.3.8 of MoRD ncluding cost of all materials ,conveyance,labour charges, etc. complete 							
	bottom of column footing	16	1.900	1.900	0.300		17.328	
	rounding	1	0.672				0.672	
						Total Quantity	18.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	18.000 cum	
						Say 18.000 cum @ Rs 1679.73 / cum	**Rs 30235.14**	
7	50.2.3.1 Pumping or Bailing out water and removing slush etc by using pump set including cost of labour, oil hire charges of pumpset, etc complete							
	For earth work 16 column	2	8.000				16.000	
	For coconut pilling	1	8.000				8.000	
	cc for footing & soling	1	8.000				8.000	
	reinforcement work,shuttering@ concrete for footing	4	8.000				32.000	
						Total Quantity	64.000 hour	
						Total Deducted Quantity	0.000 hour	
						Net Total Quantity	64.000 hour	
						Say 64.000 hour @ Rs 284.60 / hour	**Rs 18214.40**	
8	4.1.8 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)							
	column C1 to C16	16	1.700	1.700	0.200		9.248	
	below plinth beam	2*7	3.700	0.450	0.100		2.331	
	cross beam	8	5.600	0.450	0.100		2.016	
	AH floor	7	5.700	3.700	0.150		22.145	

	rounded	1	0.260				0.260	
						Total Quantity	36.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	36.000 cum	
						Say 36.000 cum @ Rs 6814.89 / cum	**Rs 245336.04**	
9	5.1.2 Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level:1:1:5:3 (1 cement 1.5 coarse sand :3 graded stone aggregate 20 mm nominal size							
	column footing C1 to C16	16	1.500	1.500	0.300		10.800	
		16	((1.5*1.5)+(.4*.3))/2		0.300		5.688	
	column up to plinth	16	0.300	0.400	1.000		1.920	
	rounded	1	0.592				0.592	
						Total Quantity	19.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	19.000 cum	
						Say 19.000 cum @ Rs 9085.14 / cum	**Rs 172617.66**	
10	5.2.2 Reinforced cement concrete work in walls (any thickness), including attached pilasters, buttresses, plinth and string courses, fillets, columns, pillars, piers, abutments, posts and struts etc. up tot floor five level excluding cost of centering, shuttering, finishing and reinforcement :1:1.5:3(1 cement : 1.5 coarse sand : 3 graded stone aggregate 20 mm nominal size)							
	plinth beam	2	28.300	0.300	0.300		5.094	
	-do- cross	8	5.800	0.300	0.400		5.569	
	column up to beam C1 to C16	16	0.400	0.300	4.000		7.680	
	roof beam long	2	28.300	0.300	0.350		5.943	
	inglind beam	2*8	3.200	0.300	0.350		5.376	
	roof slab	2	29.500	4.5500	0.120		32.214	
	rounded	1	0.124				0.124	
						Total Quantity	62.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	62.000 cum	
						Say 62.000 cum @ Rs 10954.04 / cum	**Rs 679150.48**	

11	5.9.1 Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete							
	Column base	16*4	1.500	0.300			28.800	
	Column up to plinth	16*2	0.400		1.100		14.081	
		16*2	0.300		1.100		10.560	
	rounded	1	0.559				0.559	
						Total Quantity	54.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	54.000 sqm	
						Say 54.000 sqm @ Rs 335.31 / sqm	**Rs 18106.74**	
12	5.9.3 Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform							
	roof slab bottom	2*7	3.700	3.200			165.761	
	side projection	2*2	4.500	0.600			10.800	
	slab projection	2	29.500	1.000			59.000	
	slab projection side	2	29.500	0.120			7.080	
	end side	2*2	4.500	0.120			2.160	
	rounded	1	5.199				5.199	
						Total Quantity	250.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	250.000 sqm	
						Say 250.000 sqm @ Rs 815.78 / sqm	**Rs 203945.00**	
13	5.9.5 Centering and shuttering including strutting, etc. and removal of form for:Lintels, beams, plinth beams, girders bressumers and cantilevers							
	plinth beam out side	2	28.300	0.300			16.980	
	plinth beam in side	2*7	3.700	0.300			15.541	
	cross beam	8*2	5.800	0.400			37.120	
	roof beam out side	2	28.300	0.300			16.980	
	roof beam in side	2*7	3.700	0.400			20.721	
	roof beam bottom	2*7	3.700	0.300			15.541	
	inglind beam side	2*8*2	3.200	0.350			35.840	
	inglind beam bottom	2*8	3.200	0.300			15.360	

	rounded	1	0.917				0.917	
						Total Quantity	175.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	175.000 sqm	
						Say 175.000 sqm @ Rs 649.82 / sqm	**Rs 113718.50**	
14	5.9.6 Centering and shuttering including strutting, etc. and removal of form for:Columns, Pillars, Piers, Abutments, Posts and Struts							
	column C1 to C16	16*2	0.400	4.000			51.200	
		16*2	0.300	4.000			38.400	
	rounded	1	0.400				0.400	
						Total Quantity	90.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	90.000 sqm	
						Say 90.000 sqm @ Rs 863.64 / sqm	**Rs 77727.60**	
15	5.22.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more							
	For column footing	1	16.580			100.0	1658.000	@100kg/m3
	column up to plinth	1	1.800			120.0	216.000	@120kg/m3
	rounded	1	6.000				6.000	@120kg/m3
						Total Quantity	1880.000 kilogram	
						Total Deducted Quantity	0.000 kilogram	
						Net Total Quantity	1880.000 kilogram	
						Say 1880.000 kilogram @ Rs 98.30 / kilogram	**Rs 184804.00**	
16	5.22A.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Thermo - Mechanically Treated bars of grade Fe-500D or more							
	qty vide item No 10 @ 100kg/m3	1	61.876			100.0	6187.600	@100 kg /m3
	rounded	1	12.400				12.400	@100 kg /m3
						Total Quantity	6200.000 kg	

						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	6200.000 kg	
						Say 6200.000 kg @ Rs 98.30 / kg	**Rs 609460.00**	
17	7.1.1 Random rubble masonry with hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 (1 cement : 6 coarse sand : 12 graded stone aggregate 20 mm nominal size) up to plinth level with:Cement mortar 1:6 (1 cement : 6 coarse sand)							
	below out side plinth beam	2*7	3.700	0.450	0.600		13.986	
	below cross beam	2	5.800	0.450	0.600		3.132	
	rounded	1	0.882				0.882	
						Total Quantity	18.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	18.000 cum	
						Say 18.000 cum @ Rs 7204.78 / cum	**Rs 129686.04**	
18	2.25 Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.							
	in betwen plinth beams	7	5.700	3.700	0.300		44.290	
	Back filling footing trenches	16	3.000				48.000	
	rounded	1	2.710				2.710	
						Total Quantity	95.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	95.000 cum	
						Say 95.000 cum @ Rs 258.57 / cum	**Rs 24564.15**	
19	13.7.1 12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)							
	For the roof slabs. Top	2	29.500	4.5500			268.450	
	side	2	29.500	0.130			7.670	
	end side	2	9.050	0.130			2.353	
	rounded	1	1.527				1.527	
						Total Quantity	280.000 sqm	

						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	280.000 sqm	
						Say 280.000 sqm @ Rs 401.21 / sqm	**Rs 112338.80**	
20	13.16.1 6 mm cement plaster of mix:1:3 (1 cement : 3 fine sand)							
	For cross beams side	2*8	6.200	0.350			34.720	
	bottom	8	6.200	0.300			14.880	
	long beam in side	2*7	3.700	0.400			20.721	
	long beam out side	2	28.300	0.300			16.980	
	bottom	2*7	3.700	0.300			15.541	
	slab bottom	2*7	3.700	3.200			165.761	
	roof projection end	2*2	4.500	0.600			10.800	
	out side beam projection side	2	29.500	1.050			61.950	
	column	16	4.000	1.400			89.600	
		1	4.047	1.000			4.047	
						Total Quantity	435.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	435.000 sqm	
						Say 435.000 sqm @ Rs 267.59 / sqm	**Rs 116401.65**	
21	13.4.1 12 mm cement plaster of mix:1:4 (1 cement : 4 coarse sand)							
	Auction hall floor	1	28.300	6.400			181.120	
	Rounded	1	3.880				3.880	
						Total Quantity	185.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	185.000 sqm	
						Say 185.000 sqm @ Rs 325.01 / sqm	**Rs 60126.85**	
22	13.43.1 Applying one coat of water thinnable cement primer of approved brand and manufacture on wall surface:Water thinnable cement primer							
	roof beam side & bottom	8	6.200	1.000			49.600	
	long beam out side	2	28.300	0.400			22.640	
	inside	2*7	3.700	0.400			20.721	

	bottom	2*7	3.700	0.300			15.541	
	slab bottom	2*7	3.700	3.200			165.761	
	roff projection end	2*2	4.500	0.600			10.800	
	roff projection side	2	29.500	1.050			61.950	
	column	16	4.000	1.400			89.600	
	side end	2	9.050	0.130			2.353	
	projection side	2	29.500	0.130			7.670	
	top of roof slab	2	29.500	4.550			268.450	
	rounded	1	4.914				4.914	
						Total Quantity	720.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	720.000 sqm	
						Say 720.000 sqm @ Rs 70.64 / sqm	**Rs 50860.80**	
23	13.44.1 Finishing walls with water proofing cement paint of required shade:New work (Two or more coats applied @ 3.84 kg/10 sqm)							
	slab bottom	2*7	3.700	3.200			165.761	
	roof projection end	2*2	4.500	0.600			10.800	
	roof projection side	2	29.500	1.050			61.950	
		1	1.489				1.489	
						Total Quantity	240.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	240.000 sqm	
						Say 240.000 sqm @ Rs 107.39 / sqm	**Rs 25773.60**	
24	13.46.1 Finishing walls with Acrylic Smooth exterior paint of required shade:New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm)							
	roof beam allround	8	6.200	1.000			49.600	
	long beam out side	2	28.300	0.300			16.980	
	long beam in side	2*7	3.700	0.400			20.721	
	bottom	2*7	3.700	0.300			15.541	
	column C1 to C16	16	4.000	1.400			89.600	
	top of roof slab	2	29.500	4.550			268.450	
	side	2	29.500	0.130			7.670	

	side end	2	9.050	0.130			2.353	
		1	4.085				4.085	
						Total Quantity	475.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	475.000 sqm	
						Say 475.000 sqm @ Rs 193.89 / sqm	**Rs 92097.75**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
	3 Appendix C- construction of Toilet block							
1	2.8.1 Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil							
	toilet block foundation all round	1	35.500	0.800	0.750		21.300	
	crosswall long	2	11.500	0.800	0.750		13.800	
	cross	1	6.050	0.800	0.750		3.630	
		1	3.150	0.800	0.750		1.891	
	bath room	1	4.800	0.800	0.750		2.880	
	ramp	2	4.500	0.800	0.750		5.400	
	step	1	3.500	1.200	0.600		2.520	
		1	3.000	0.800	0.750		1.801	
	setitank	1	6.700	2.400	2.000		32.160	
	sock pit	1	1.800	1.800	1.500		4.860	
		1	4.758				4.758	
						Total Quantity	95.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	95.000 cum	
						Say 95.000 cum @ Rs 296.94 / cum	**Rs 28209.30**	
2	2.26.1 Extra for every additional lift 1.5 m or part there of in excavation / banking excavated or stacked materials.All kinds of soil							
	tank	1	6.700	2.400	0.500		8.040	
	rounded	1	1.960				1.960	
						Total Quantity	10.000 cum	

						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	10.000 cum	
						Say 10.000 cum @ Rs 106.37 / cum	**Rs 1063.70**	
3	4.1.8 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)							
	toilet block foundation all round	1	35.500	0.800	0.150		4.260	
	crosswall long	2	11.500	0.800	0.150		2.761	
	cross	1	6.050	0.800	0.150		0.726	
		1	3.150	0.800	0.150		0.378	
	bath room	1	4.800	0.800	0.150		0.576	
	ramp	2	4.500	0.800	0.150		1.080	
	step	1	3.500	1.200	0.150		0.630	
		1	3.000	0.800	0.150		0.361	
	setitank	1	6.700	2.400	0.200		3.216	
	floor room	1	12.150	4.800	0.100		5.833	
	ramp& varandha	1	13.500	1.200	0.100		1.620	
	rounded	1	0.559				0.559	
						Total Quantity	22.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	22.000 cum	
						Say 22.000 cum @ Rs 6814.89 / cum	**Rs 149927.58**	
4	7.1.1 Random rubble masonry with hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 (1 cement : 6 coarse sand : 12 graded stone aggregate 20 mm nominal size) up to plinth level with:Cement mortar 1:6 (1 cement : 6 coarse sand)							
	toilet block foundation all round	1	35.500	0.600	0.600		12.780	
	crosswall long	2	11.500	0.600	0.600		8.280	
	cross	1	6.050	0.600	0.600		2.178	
		1	3.150	0.600	0.600		1.134	
	bath room	1	4.800	0.600	0.600		1.728	
	ramp	2	4.500	0.600	0.600		3.240	

	step	1	3.500	1.200	0.450		1.891	
		1	3.000	0.600	0.600		1.080	
	toilet block basement all round	1	35.500	0.450	0.450		7.189	
	crosswall long	2	11.500	0.450	0.450		4.658	
	cross	1	6.050	0.450	0.450		1.226	
		1	3.150	0.450	0.450		0.638	
	bath room	1	4.800	0.450	0.450		0.973	
	ramp	2	3.150	0.450	0.300		0.851	
		1	3.000	0.450	0.450		0.608	
	partition	10	1.500	0.450	0.450		3.038	
	rounded	1	0.508				0.508	
						Total Quantity	52.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	52.000 cum	
						Say 52.000 cum @ Rs 7204.78 / cum	**Rs 374648.56**	
5	2.25 Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.							
	for foundation	1	11.550	3.900	0.600		27.027	
	varandha	1	7.000	0.750	0.600		3.150	
	rounded	1	4.823				4.823	
						Total Quantity	35.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	35.000 cum	
						Say 35.000 cum @ Rs 258.57 / cum	**Rs 9049.95**	
6	5.2.2 Reinforced cement concrete work in walls (any thickness), including attached pilasters, buttresses, plinth and string courses, fillets, columns, pillars, piers, abutments, posts and struts etc. up tot floor five level excluding cost of centering, shuttering, finishing and reinforcement :1:1.5:3(1 cement : 1.5 coarse sand : 3 graded stone aggregate 20 mm nominal size)							
	basement allround	1	35.500	0.450	0.100		1.598	
	cross	1	11.500	0.450	0.100		0.518	
		1	6.050	0.450	0.100		0.273	

		1	3.150	0.450	0.100		0.142	
	bath	1	4.800	0.450	0.100		0.217	
	ramp	1	3.150	0.450	0.100		0.142	
		1	3.000	0.450	0.100		0.135	
	partition	10	1.500	0.450	0.100		0.675	
	lintel	1	76.000	0.150	0.150		1.710	
	roof slab	1	12.750	5.800	0.120		8.874	
	slop	1	39.450	1.000	0.120		4.734	
	tank bottom	1	6.000	2.100	0.150		1.891	
	beam	1	2.100	0.200	0.200		0.085	
	cover slab	1	6.000	2.100	0.120		1.512	
		1	1.800	1.800	0.120		0.389	
	rounded	1	0.105				0.105	
						Total Quantity	23.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	23.000 cum	
						Say 23.000 cum @ Rs 10954.04 / cum	**Rs 251942.92**	
7	5.9.3 Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform							
	basement top	2	35.500	0.100			7.101	
	cross	2	11.500	0.100			2.301	
		2	6.050	0.100			1.210	
		2	3.150	0.100			0.630	
	bath	2	4.800	0.100			0.960	
	ramp	2	6.150	0.100			1.231	
	partition	10*2	1.500	0.100			3.001	
	lintel	2	76.000	0.150			22.800	
	roof slab	1	12.750	5.800			73.950	
	slop	1	39.450	1.000			39.450	
	tank bottom	4	10.200	0.150			6.120	
	beam	1	2.100	0.600			1.260	
	cover slab	12	5.100	0.120			7.344	

		3	4.800	0.120			1.728	
		1	0.914				0.914	
						Total Quantity	170.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	170.000 sqm	
						Say 170.000 sqm @ Rs 815.78 / sqm	**Rs 138682.60**	
8	5.22A.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Thermo - Mechanically Treated bars of grade Fe-500D or more							
	qty of cc	1	22.895			100.0	2289.500	@100kg/ m3
	rounded	1	10.500				10.500	@100kg/ m3
						Total Quantity	2300.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	2300.000 kg	
						Say 2300.000 kg @ Rs 98.30 / kg	**Rs 226090.00**	
9	50.6.2.2 Solid masonry using pre cast solid blocks (factory made) of size 30x20x15cm or nearest available size confirming to IS 2185 part I of 1979 for super structure up to floor two level with thickness 15cm in : CM 1:6 (1 cement : 6 coarse sand) etc complete							
	wall all round	1	34.500	2.800	0.150		14.490	
	cross wal	1	12.150	2.800	0.150		5.103	
	centre cross	1	3.150	2.800	0.150		1.323	
		1	6.050	2.800	0.150		2.541	
	bath	1	4.800	2.800	0.150		2.016	
	septitank	1	16.200	1.800	0.200		5.833	
	step	1	3.000	0.600	0.450		0.810	
	rounded	1	0.593				0.593	
	shutter	1	3.000	2.400	0.150		-1.079	
	door D DA toilet	2	1.000	2.100	0.150		-0.630	
						Total Quantity	32.709 cum	
						Total Deducted Quantity	-1.709 cum	
						Net Total Quantity	31.000 cum	
						Say 31.000 cum @ Rs 6984.85 / cum	**Rs 216530.35**	

10	50.6.3.2 Solid block masonry using pre cast solid blocks (Factory made) of size 40x20x10 cm or nearest available size confirming to IS 2185 part I of 1979 for super structure up to floor two level for 10 cm thick wall in : CM 1:6 (1 cement : 6 coarse sand) including cost of scaffolding complete							
	toilet partition	10	1.500	2.800	0.100		4.200	
	urinal partition	2	1.000	1.400	0.100		0.280	
	parapet	1	37.100	0.600	0.100		2.227	
	seititank partition	2	1.700	1.000	0.100		0.340	
	sock pit	4	1.700	1.200	0.100		0.817	
	rounded	1	0.459				0.459	
	door D1	9	0.700	2.100	0.100		-1.323	
						Total Quantity	8.323 cum	
						Total Deducted Quantity	-1.323 cum	
						Net Total Quantity	7.000 cum	
						Say 7.000 cum @ Rs 7823.61 / cum	**Rs 54765.27**	
11	13.1.1 12 mm cement plaster of mix:1:4 (1 cement : 4 fine sand)							
	out side wall	1	35.300	2.800			98.840	
	Parapet	1	37.100	1.400			51.940	
	toilet inside	10	5.400	2.800			151.200	
	DA toilet	2	6.600	2.800			36.960	
	out side	2	4.800	2.800			26.880	
	bath	1	6.500	2.800			18.200	
	partition	2	3.150	2.800			17.640	
		1	5.300	2.800			14.840	
		1	5.500	2.800			15.400	
		1	3.200	2.800			8.960	
		1	4.850	2.800			13.580	
		1	2.500	2.800			7.000	
	urinal partition	2	2.100	1.500			6.301	
	under side slab	1	12.750	5.800			73.950	
		1	39.450	1.000			39.450	
	rounded	1	5.927				5.927	
	door D	2	1.000	2.100			-4.200	

	toilet door D1	11	0.700	2.100			-16.169	
	ventilator	15	0.600	0.500			-4.500	
	shutter	1	3.000	2.400			-7.199	
						Total Quantity	587.068 sqm	
						Total Deducted Quantity	-32.068 sqm	
						Net Total Quantity	555.000 sqm	
						Say 555.000 sqm @ Rs 314.09 / sqm	**Rs 174319.95**	
12	13.7.1 12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)							
	slab top	1	12.750	5.800			73.950	
		1	39.450	1.000			39.450	
	rounded	1	1.600				1.600	
						Total Quantity	115.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	115.000 sqm	
						Say 115.000 sqm @ Rs 401.21 / sqm	**Rs 46139.15**	
13	13.7.2 12 mm cement plaster finished with a floating coat of neat cement of mix:1:4 (1 cement : 4 fine sand)							
	Septi tank inside	1	15.400	1.800			27.721	
	bottom	1	6.000	1.700			10.200	
	partition wall	2*2	1.700	1.000			6.800	
	roumnded	1	0.279				0.279	
						Total Quantity	45.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	45.000 sqm	
						Say 45.000 sqm @ Rs 386.36 / sqm	**Rs 17386.20**	
14	8.31 Providing and fixing Ist quality ceramic glazed wall tiles conforming to IS: 15622(thickness to be specified by the manufacturer), of approved make, in all colours,shades except burgundy, bottle green, black of any size as approved by Engineerin-Charge,in skirting, risers of steps and dados, over 12 mm thick bed of cementmortar 1:3 (1 cement : 3 coarse sand) and jointing with grey cement slurry @3.3kg per sqm, including pointing in white cement mixed with pigment of matchingshade complete.							
	toilet	11	4.700	1.800			93.060	
	DA toilet	2	5.600	1.800			20.160	
	bath	1	5.800	1.800			10.440	

	urinal portion	3	2.600	1.600			12.480	
	rounded	1	3.860				3.860	
						Total Quantity	140.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	140.000 sqm	
						Say 140.000 sqm @ Rs 1212.78 / sqm	**Rs 169789.20**	
15	11.37 Providing and laying Ceramic glazed floor tiles of size 300x300 mm (thickness to be specified by the manufacturer), of 1st quality conforming to IS : 15622, of approved make, in colours such as White, Ivory, Grey, Fume Red Brown, laid on 20 mm thick cement mortar 1:4 (1 Cement : 4 Coarse sand), including pointing the joints with white cement and matching pigment etc., complete.							
	inside floor	1	12.150	4.800			58.320	
	Rounded	1	1.680				1.680	
						Total Quantity	60.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	60.000 sqm	
						Say 60.000 sqm @ Rs 1091.02 / sqm	**Rs 65461.20**	
16	od207112/2023_2024 :Providing and laying industrial grade antiskid tiles of size 300x300mm with thickness 9mm or nearest with water absorption less than 0.08 % and conforming to I.S. 15622, of approved make, in all colours & shades,laid on 20 mm thick cement mortar 1:4 (1 cement : 4 coarse sand), including grouting the joint with white cement & matching pigments etc. complete.							
	ramp	2	5.200	1.200			12.480	
		1	3.500	1.200			4.200	
	step	3	3.000	0.450			4.051	
	Rounded	1	2.269				2.269	
						Total Quantity	23.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	23.000 sqm	
						Say 23.000 sqm @ Rs 1276.95 / sqm	**Rs 29369.85**	
17	13.43.1 Applying one coat of water thinnable cement primer of approved brand and manufacture on wall surface:Water thinnable cement primer							
	area vide item no 11	1	555.000				555.000	
						Total Quantity	555.000 sqm	
						Total Deducted Quantity	0.000 sqm	

						Net Total Quantity	555.000 sqm	
						Say 555.000 sqm @ Rs 70.64 / sqm	**Rs 39205.20**	
18	13.46.1 Finishing walls with Acrylic Smooth exterior paint of required shade:New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm)							
	out side wall	1	35.300	2.800			98.840	
	Parapet	1	37.100	1.400			51.940	
	rounded	1	4.220				4.220	
						Total Quantity	155.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	155.000 sqm	
						Say 155.000 sqm @ Rs 193.89 / sqm	**Rs 30052.95**	
19	13.83.2 Wall painting with premium acrylic emulsion paint of interior grade, having VOC (Volatile including applying additional coats wherever required to achieve even shade and colour.Two coats							
	toilet inside	10	5.400	1.000			54.000	
	DA toilet	2	6.600	1.000			13.200	
	out	2	4.800	2.800			26.880	
	bath	1	6.500	1.000			6.500	
	partition	2	3.150	2.800			17.640	
		1	5.300	2.800			14.840	
		1	5.500	2.800			15.400	
		1	3.200	2.800			8.960	
		1	4.850	2.800			13.580	
		1	2.500	2.800			7.000	
	urinal partition	2	2.100	1.500			6.301	
	under side slab	1	12.750	5.800			73.950	
		1	39.450	1.000			39.450	
	rounded	1	4.367				4.367	
	door D	2	1.000	2.100			-4.200	
	toilet door	11	0.700	2.100			-16.169	
	ventilator	15	0.600	0.500			-4.500	
	shutter	1	3.000	2.400			-7.199	
						Total Quantity	302.068 sqm	

						Total Deducted Quantity	-32.068 sqm	
						Net Total Quantity	270.000 sqm	
						Say 270.000 sqm @ Rs 134.10 / sqm	**Rs 36207.00**	
20	9.117.1 Providing and fixing factory made uPVC door frame made of uPVC extruded sections having an overall dimension as below (tolerance ±1 mm), with wall thickness 2.0mm (±0.2 mm), corners of the door frame to be jointed with galvanized brackets and stainless steel screws, joints mitred and plastic welded. The hinge side vertical of the frames reinforced by galvanized M.S. tube of size 19 x 19 mm and 1 mm (± 0.1 mm) wall thickness and 3 nos. stainless steel hinges fixed to the frame complete as per manufacturer's specification and direction of Engineer-in-chargeExtruded section profile size 48x40 mm							
	Toilet door 70x210	11	5.600				61.600	
	DA toilet,100x210	2	6.200				12.400	
	rounded	1	1.000				1.000	
						Total Quantity	75.000 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	75.000 metre	
						Say 75.000 metre @ Rs 260.94 / metre	**Rs 19570.50**	
21	9.118.1 Providing and fixing to existing door frames24 mm thick factory made PVC door shutters made of styles and rails of a uPVC hollow section of size 59x24 mm and wall thickness 2 mm (± 0.2 mm) with inbuilt edging on both sides. The styles and rails mitred and joint at the corners by means of M.S. galvanised/plastic brackets of size 75x220 mm having wall thickness 1.0 mm and stainless steel screws. The styles of the shutter reinforced by inserting galvanised M.S. tube of size 20x20 mm and 1 mm (± 0.1 mm) wall thickness. The lock rail made up of 'H' section, a uPVC hollow section of size 100x24 mm and 2 mm (± 0.2 mm) wall thickness,fixed to the shutter styles by means of plastic/galvanised M.S. 'U' cleats. The shutter frame filled with a uPVC multi-chambered single panel of size not less than 620 mm, having over all thickness of 20 mm and 1 mm (± 0.1 mm) wall thickness. The panels filled vertically and tie bar at two places by inserting horizontally 6 mm galvanised M.S. rod and fastened with nuts and washers, complete as per manufacturer's specification and direction of Engineer-in-charge(For W.C. and bathroom door shutter).							
	Toilet door 70x210	11	0.700	2.100			16.170	
	DA toilet,100x210	2	1.000	2.100			4.200	
	rounded	1	0.630				0.630	
						Total Quantity	21.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	21.000 sqm	
						Say 21.000 sqm @ Rs 2072.49 / sqm	**Rs 43522.29**	
22	9.147B.1							

	543SUB HEAD : 9 - WOOD & PVC WORK9.147BProviding and fixing factory made uPVC white colour fixed glazed windows/ventilators comprising of uPVC multi-chambered frame and mullion (where everrequired) extruded profiles duly reinforced with 1.60 ± 0.2 mm thick galvanizedmild steel section made from roll forming process of required length (shape &size according to uPVC profile), , uPVC extruded glazing beads of appropriatedimension, EPDM gasket, G.I fasteners 100 x 8 mm size for fixing frame to finishedwall, plastic packers, plastic caps and necessary stainless steel screws etc.Profile of frame shall be mitred cut and fusion welded at all corners, mullion (ifrequired) shall be also fusion welded including drilling of holes for fixinghardware's and drainage of water etc. After fixing frame the gap between frameand adjacent finished wall shall be filled with weather proof silicon sealant overbacker rod of required size and of approved quality, all complete as per approveddrawing & direction of Engineer-in-Charge. (Single / double glass panes andsilicon sealant shall be paid separately). Note: For uPVC frame, sash and mullion extruded profiles minus 5% tolerancein dimension i.e. in depth & width of profile shall be acceptable.Fixed window / ventilator made of (small series) frame 47 x 50 mm & mullion 47x 68 mm both having wall thickness of 1.9 ± 0.2 mm and single glazing bead ofappropriate dimension. (Area upto 0.75 sqm.)							
	for ventilator	15	0.600	0.500			4.500	
						Total Quantity	4.500 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	4.500 sqm	
						Say 4.500 sqm @ Rs 7626.06 / sqm	**Rs 34317.27**	
23	10.3 Providing and fixing in position collapsible steel shutters with vertical channels 20x10x2 mm and braced with flat iron diagonals 20x5 mm size, with top and bottom rail of T-iron 40x40x6 mm, with 40 mm dia steel pulleys, complete with bolts, nuts,locking arrangement, stoppers, handles, including applying a priming coat of approved steel primer .							
	Front shutter	1	3.500	2.400			8.400	
	Rounded	1	0.600				0.600	
						Total Quantity	9.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	9.000 sqm	
						Say 9.000 sqm @ Rs 10205.93 / sqm	**Rs 91853.37**	
24	10.28 Providing and fixing stainless steel (Grade 304) railing made of Hollow tubes, channels, plates etc., including welding, grinding, buffing, polishing and making curvature (wherever required) and fitting the same with necessary stainless steel nuts and bolts complete, i/c fixing the railing with necessary accessories & stainless steel dash fasteners, stainless steel bolts etc., of required size on the top of the floor or the side of waist slab with suitable arrangement as per approval of Engineer-in-charge, (for payment purpose only weight of stainless steel members shall be considered excluding fixing accessories such as nuts, bolts, fasteners etc.)							
	hand rail	2	6.000			20.0	240.000	@20kg/m

						Total Quantity	240.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	240.000 kg	
						Say 240.000 kg @ Rs 677.34 / kg	**Rs 162561.60**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
	4 Appendix D- construction of Parking Area							
1	16.78.1 Construction of granular sub- base by Providing close graded Material conforming to specifications, mixing in a mechanical mix plant at OMC, Carriage of mixed material by tippers to work site, for all leads & lifts, spreading in uniform layers of specified thickness with motor grader on prepared surface and compacting with vibratory power roller to achieve the desired density, complete as per specifications and directions of Engineer-in- Charge.With Material conforming to Grade - I (size range 75 mm to 0.075 mm) having CBR Value- 30							
	Auction hall front	1	40.000	30.000	0.150		180.000	
	side	2	6.000	6.000	0.150		10.800	
	AH west side	1	40.000	15.000	0.150		90.000	
	for road	1	30.000	6.000	0.150		27.000	
	rounded	1	4.200				4.200	
						Total Quantity	312.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	312.000 cum	
						Say 312.000 cum @ Rs 2963.59 / cum	**Rs 924640.08**	
2	16.80 Construction of dry lean cement concrete sub base over a prepared sub - grade with coarse and fine aggregate conforming to IS : 383, the size of coarse aggregate not exceeding 25 mm, aggregate cement ration not to exceed 15:1, aggregate gradation after blending to be as per specification, cement content not to be less than 150 Kg/ cum, optimum moisture content to be determined during trial length construction, concrete strength not to be less than 10 Mpa at 7 days, mixed in a batching plant, transported to site, for all leads & lifts, laid with a mechanical paver, compacting with 8-10 tonne vibratory roller, finishing and curing etc. complete as per direction of Engineer-in-charge							
	Auction hall front	1	40.000	30.000	0.150		180.000	
	side	2	6.000	6.000	0.150		10.800	
	AH west side	1	40.000	15.000	0.150		90.000	
	for road	1	30.000	6.000	0.150		27.000	
	rounded	1	4.200				4.200	
						Total Quantity	312.000 cum	
						Total Deducted Quantity	0.000 cum	

						Net Total Quantity	312.000 cum	
						Say 312.000 cum @ Rs 4569.25 / cum	**Rs 1425606.00**	
3	16.43.1 Providing and laying design mix cement concrete of M-30 grade, in roads/ taxi tracks/ runways, using cement content as per design mix, using coarse sand and graded stone aggregate of 40 mm nominal size in appropriate proportions as per approved & specified design criteria, providing dowel bars with sleeve/tie bars wherever required, laying at site, spreading and compacting mechanically by using needle and surface vibrators, levelling to required slope/ camber, finishing with required texture, including steel form work with sturdy M.S. channel sections, curing, making provision for contraction / expansion, construction & longitudinal joints (10 mm wide x 50 mm deep) by groove cutting machine, providing and filling joints with approved joint filler and sealants, complete all as per direction of Engineer-in-charge (Item of joint fillers, sealants, dowel bars with sleeve/tie bars to be paid separately). Note: Cement content considered in M-30 is @340 kg/cum. Excess/less cement used as per design mix is payable/ recoverable separately.Cement concrete prepared with batch mixing machine								
	Auction hall front	1	40.000	30.000	0.150		180.000	
	side	2	6.000	6.000	0.150		10.800	
	AH west side	1	40.000	15.000	0.150		90.000	
	for road	1	30.000	6.000	0.150		27.000	
	rounded	1	4.200				4.200	
						Total Quantity	312.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	312.000 cum	
						Say 312.000 cum @ Rs 10302.33 / cum	**Rs 3214326.96**	
4	5.22A.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Thermo - Mechanically Treated bars of grade Fe-500D or more							
	qty of CC	1	307.800			75.0	23085.000	@75Kg/m3
	rounded	1	15.000				15.000	@75Kg/m3
						Total Quantity	23100.000 kg	
						Total Deducted Quantity	0.000 kg	
						Net Total Quantity	23100.000 kg	
						Say 23100.000 kg @ Rs 98.30 / kg	**Rs 2270730.00**	
5	16.44 Extra for providing and mixing hardening compound of approved quality as per manufacturer's specification in cement concrete.							

	q t y o f c c 307.8*340=104652(2093 bags	1	2093.000			0.2	418.600	@.20 Kg/bag
	Rounded	1	6.400				6.400	@.20 Kg/bag
						Total Quantity	425.000 Litre	
						Total Deducted Quantity	0.000 Litre	
						Net Total Quantity	425.000 Litre	
						Say 425.000 Litre @ Rs 59.86 / Litre	**Rs 25440.50**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
	5 Appendix E - Construction of Drain							
1	2.8.1 Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil							
	main drain from Auction hall to sump	1	50.000	1.300	1.000		65.000	
						Total Quantity	65.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	65.000 cum	
						Say 65.000 cum @ Rs 296.94 / cum	**Rs 19301.10**	
2	2.6.1 Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil							
	Pit of sump	1	8.200	4.000	2.450		80.360	
	soak pit 2m dia	1	3.140	1*1	2.100		6.594	
	round of	1	3.046				3.046	
						Total Quantity	90.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	90.000 cum	
						Say 90.000 cum @ Rs 214.03 / cum	**Rs 19262.70**	
3	4.1.8 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40							

	nominal size)							
	for drain	1	50.000	1.300	0.150		9.750	
	sump bottom	1	8.200	4.000	0.200		6.560	
	round of	1	0.690				0.690	
						Total Quantity	17.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	17.000 cum	
						Say 17.000 cum @ Rs 6814.89 / cum	**Rs 115853.13**	
4	5.1.2 Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level:1:1:5:3 (1 cement 1.5 coarse sand :3 graded stone aggregate 20 mm nominal size							
	drain bottom slab	1	50.000	1.200	0.100		6.000	
	side wall	2	50.000	1.000	0.200		20.000	
	cover slad for drain 50/.5	100	1.000	0.500	0.150		7.500	
	cover slab sump	16	3.500	0.500	0.120		3.360	
	do beam	1	7.500	0.300	0.300		0.675	
	cover slab soak pit	1	3.140	1.100	0.120		0.415	
	round	1	0.050				0.050	
						Total Quantity	38.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	38.000 cum	
						Say 38.000 cum @ Rs 9085.14 / cum	**Rs 345235.32**	
5	5.9.1 Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete							
	side wall drain out	2	50.000	1.000			100.000	
	side wall drain in	2	50.000	0.900			90.000	
						Total Quantity	190.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	190.000 sqm	
						Say 190.000 sqm @ Rs 335.31 / sqm	**Rs 63708.90**	
6	5.9.5 Centering and shuttering including strutting, etc. and removal of form for:Lintels, beams, plinth beams,							

	girders bressumers and cantilevers							
	For cover slab drain 105 x 50 x 15 cm	100	3.100	0.150			46.500	
	For cover slab Effluent tank sides	16	8.000	0.120			15.360	
	beam	1	7.500	0.900			6.750	
	Rounded	1	1.390				1.390	
						Total Quantity	70.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	70.000 sqm	
						Say 70.000 sqm @ Rs 649.82 / sqm	**Rs 45487.40**	
7	5.22A.1 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete above plinth level.Mild steel and Medium Tensile steel bars							
	Qty of CC 38	1	38.000			90.0	3420.000	
						Total Quantity	3420.000 kilogram	
						Total Deducted Quantity	0.000 kilogram	
						Net Total Quantity	3420.000 kilogram	
						Say 3420.000 kilogram @ Rs 96.68 / kilogram	**Rs 330645.60**	
8	50.6.1.1 Solid block masonry using pre cast solid blocks (factory made) of size 40x20x20cm or nearest available size confirming to IS 2185 part 1 of 1979 for foundation and plinth with thickness 20 cm and above in: CM 1:6 (1 cement : 6 coarse sand) etc complete							
	tank side wall	1	21.900	0.200	2.500		10.950	
	soak pit 2.00m dia - bottom	1	6.280	0.200	0.300		0.377	
	Rounded	1	0.673				0.673	
						Total Quantity	12.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	12.000 cum	
						Say 12.000 cum @ Rs 5908.32 / cum	**Rs 70899.84**	
9	6.23 Honey-comb brick work 10/11.4 cm thick with common burnt clay bricks of class designation 7.5 in super structure above plinth level upto floor V level with cement mortar 1:4 (1 cement : 4 coarse sand).							
	soak pit 2.00m dia - bottom	1	6.280	1.300			8.165	

	Rounded	1	0.835				0.835	
						Total Quantity	9.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	9.000 sqm	
						Say 9.000 sqm @ Rs 699.37 / sqm	**Rs 6294.33**	
10	13.7.2 12 mm cement plaster finished with a floating coat of neat cement of mix:1:4 (1 cement : 4 fine sand)							
	for Drain side wall - inside	1	50.000	2.600			130.000	
	Effluent tank side wall	2	31.600	2.500			158.000	
	cross wall	2	3.200	2.500			16.000	
	bottom	1	7.600	3.200			24.320	
	Rounded	1	1.680				1.680	
						Total Quantity	330.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	330.000 sqm	
						Say 330.000 sqm @ Rs 386.36 / sqm	**Rs 127498.80**	

Sl No	Description	No	L	B	D	CF	Quantity	Remark
6 Seawall Strengthening								
Lump-Sum Total							**Rs 32500000.00**	

	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**7 Sub soil investigation**							
Lump-Sum Total							**Rs 1900000.00**	

	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**8 Water supply and sanitary arrangement**							
Lump-Sum Total							**Rs 2500000.00**	

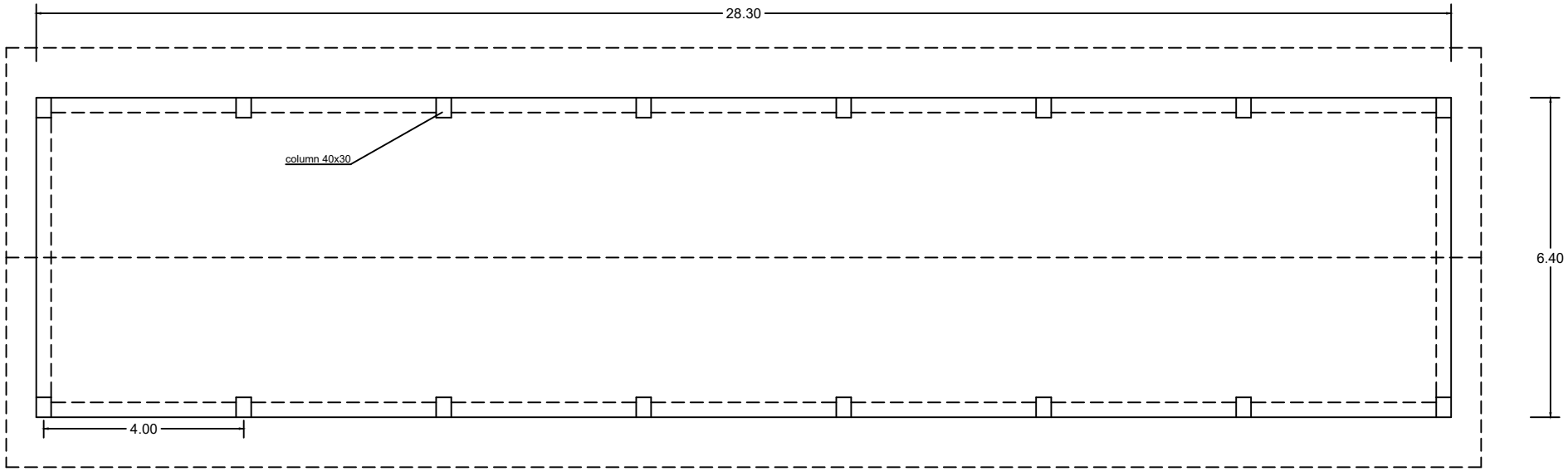
	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**9 Electrification and yard lighting**							
Lump-Sum Total							**Rs 2300000.00**	

	Sl No	Description	No	L	B	D	CF	Quantity
Remark	**10 Unforeseen charges @ 2.5%**							
Lump-Sum Total							**Rs 4950000.00**	

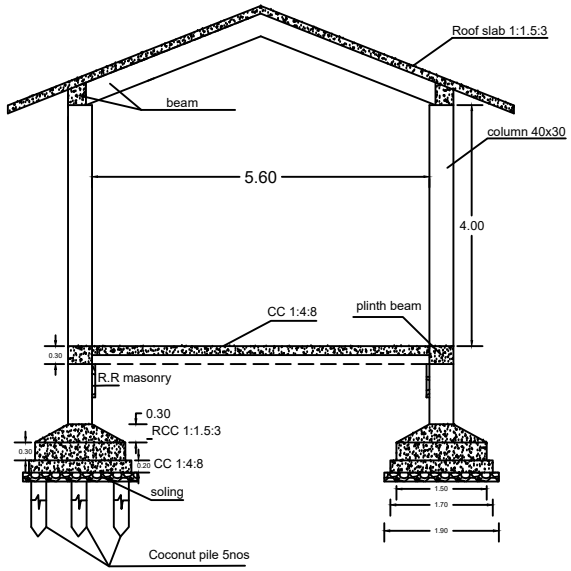
	Provision for GST payments (in %) @	**18.0%**
Amount reserved for GST payments		**35991941.80**
Total		**235947173.80**

Lumpsum for round off	**52826.20**
	TOTAL Rs 236000000.00
	Rounded Total Rs 23,60,00,000
	Rupees Twenty Three Crore Sixty Lakh Only

(Cost Index Applied for this estimate is 35.59%)



FLC Auction hall plan



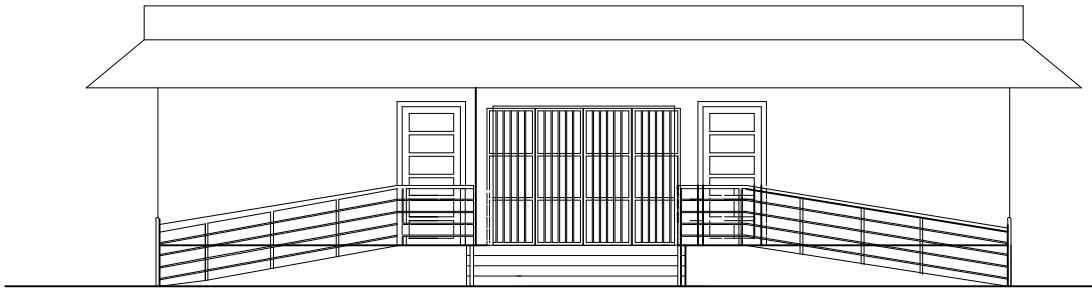
FLC Auction hall cross section

KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION

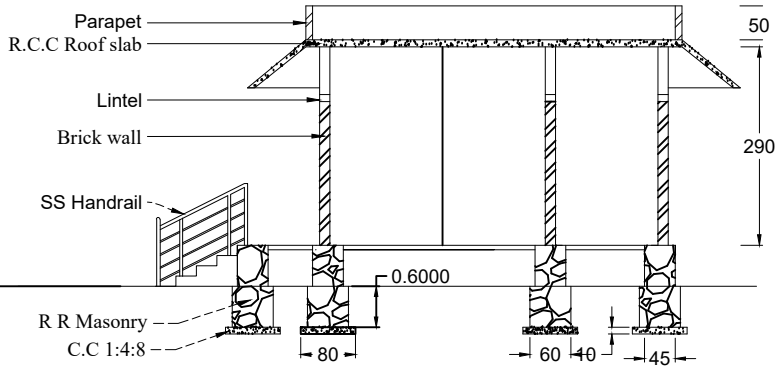
KSCADC

DEVELOPMENT OF VIPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT SAIDH MOHAMMED BEACH

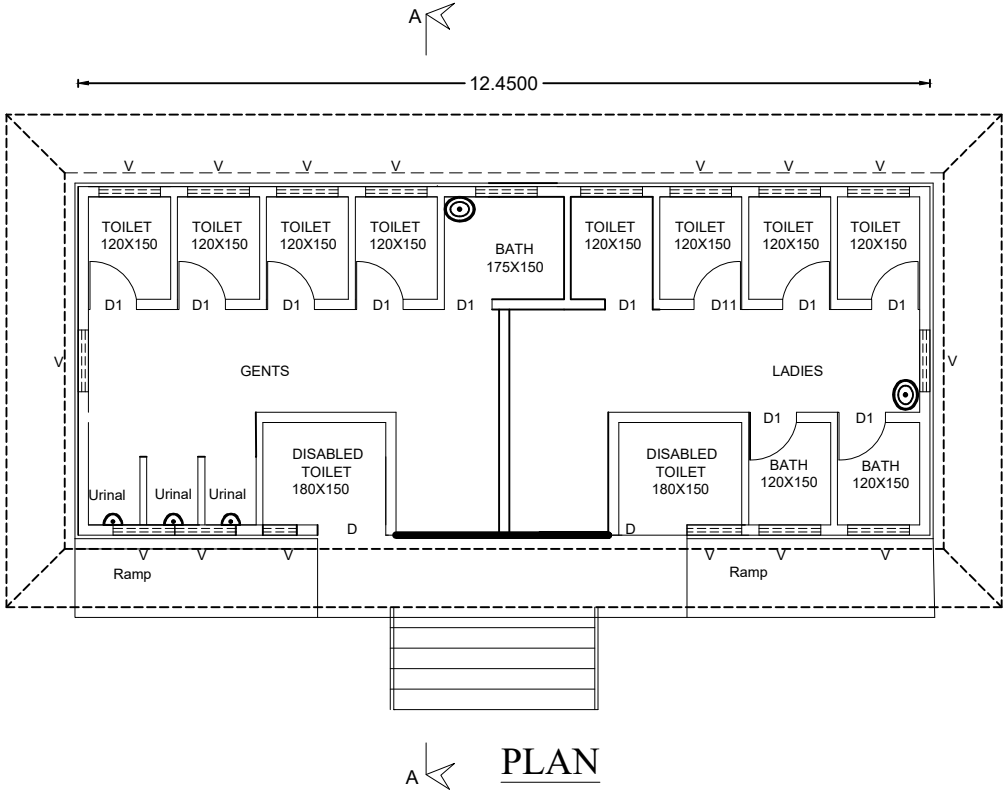
DRAWING NO:		ASSISTANT ENGINEER:		**ASSISTANT ENGINEER:** SIGNATURE:	**ASSISTANT EXECUTIVE ENGINEER:** SIGNATURE:
DATE:		DRAWN:			
TYPE:	**DRAWING**	**REVISION**		**STRUCTURAL CONSULTANT:** DESIGNED & CHECKED BY	**CHIEF ENGINEER:** SIGNATURE:
TITLE:	FLC AUCTION HALL PLAN & SECTION	1.			
		2.			



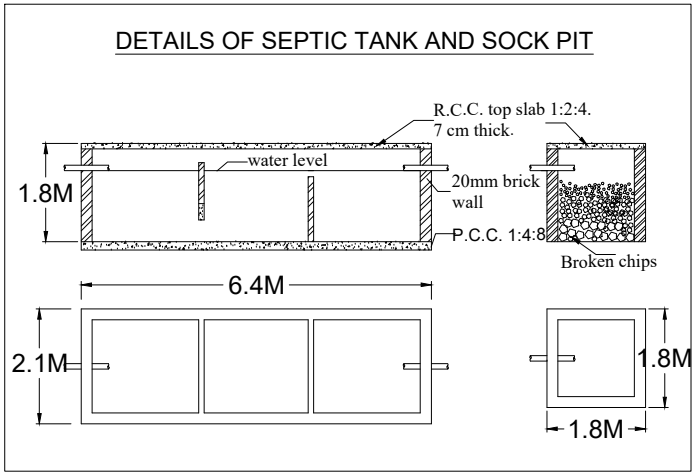
ELEVATION



Section on A A



PLAN

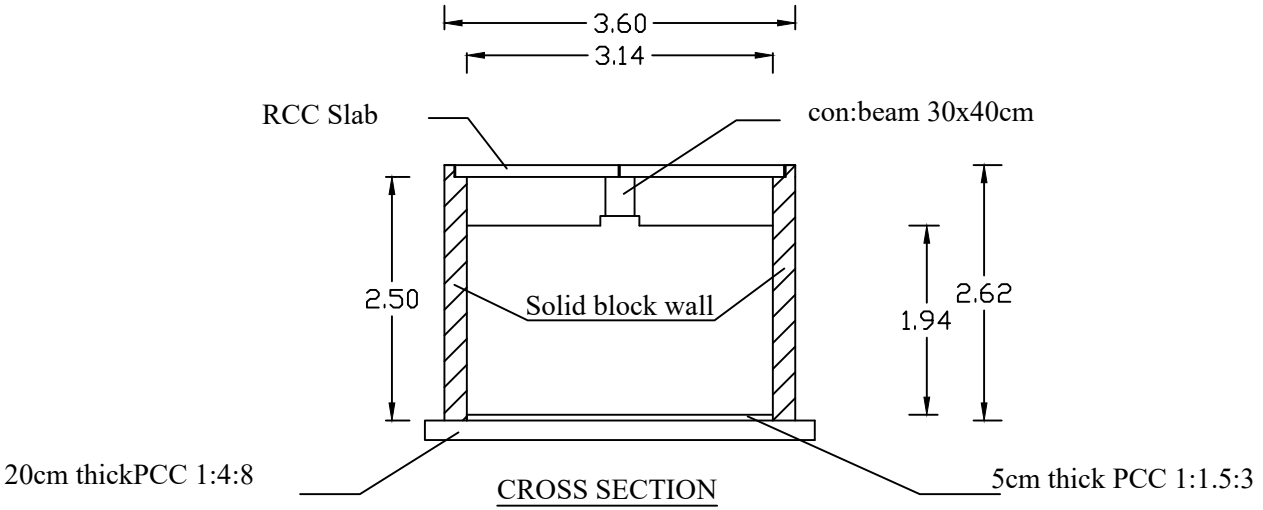


KSCADC

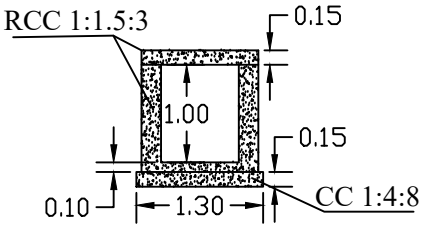
KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION

DEVELOPMENT OF VIPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT SAID MOHAMMED BEACH

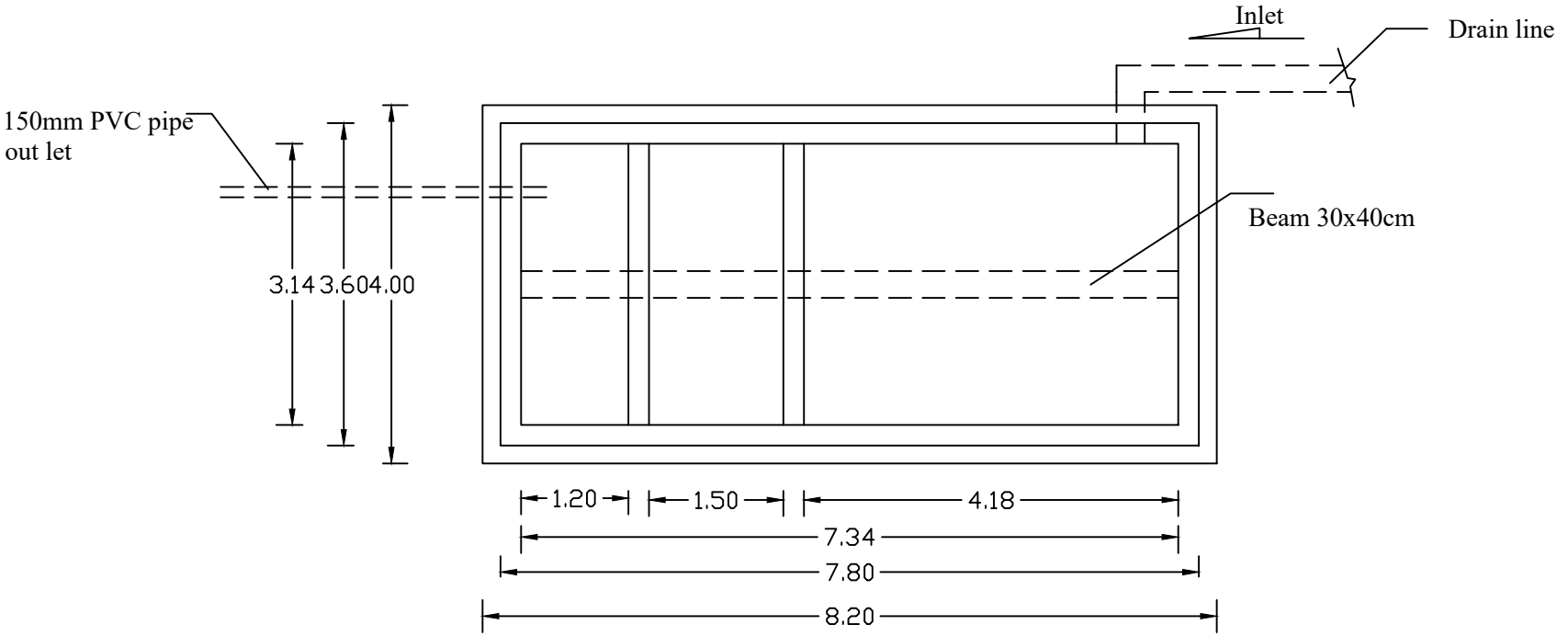
DRAWING NO:		ASSISTANT ENGINEER:		**ASSISTANT ENGINEER:** SIGNATURE:	**ASSISTANT EXECUTIVE ENGINEER:** SIGNATURE:
DATE:		DRAWN:			
TYPE:	**DRAWING**	**REVISION**		**STRUCTURAL CONSULTANT:** DESIGNED & CHECKED BY	**CHIEF ENGINEER:** SIGNATURE:
TITLE:	TOILET BLOCK	1.			
		2.			



CROSS SECTION



Drain Cross section



PLAN

KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION	DEVELOPMENT OF VIPIN -MUNAMBAM COASTAL STRETCH INCLUDING COASTAL PROTECTION -CONSTRUCTION OF FISH LANDING CENTRE AT SAIDH MOHAMMED BEACH				
	DRAWING NO:		ASSISTANT ENGINEER:		ASSISTANT ENGINEER: SIGNATURE:
	DATE:		DRAWN:		ASSISTANT EXECUTIVE ENGINEER: SIGNATURE:
	TYPE: DRAWING		REVISION		STRUCTURAL CONSULTANT: DESIGNED & CHECKED BY
	TITLE:	FISH LANDING CENTRE DRAIN AND TREATMENT TANK	1. 2.		CHIEF ENGINEER: SIGNATURE:

ANNEXURE 2

FINAL REPORT

SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT

Client

Kerala State Coastal Area Development Corporation Limited (KSCADC) & GIDA

Consultants

Prof. V.Sundar

Prof. S. A. Sannasiraj

Department of Ocean Engineering
Indian Institute of Technology Madras
Chennai 600 036, India

MAY 2022

Table of Contents

Table of Figures

List of Tables

1.0 BACKGROUND

The Kerala coastal stretch has been traditionally protected by seawalls and is facing a severe threat of coastal erosion owing to the continued intense wave and tide induced forces experienced along the exposed coastal stretches. It is necessary to protect the coastal stretch extending between Vypin and Munambam in order to conserve the flourishing fishing, industrial and tourism activities; in addition to preserving the state highway road which runs parallel to the said coastline. Kerala State Coastal Area Development Corporation Limited (KSCADC) has approached Prof. V. Sundar, Department of Ocean Engineering, IIT Madras to carry out a systematic investigation on the stability of defined shoreline along the Vypin coast stretches north of Cochin Port entrance in the Ernakulam district with specific reference to shoreline erosion. Accordingly, Prof. V. Sundar had detailed discussions with Mr. P.I. Sheik Pareeth, Managing Director, KSCADC and concerned officials on 08/12/2018. This technical and commercial proposal is made based on the requirement from KSCADC through lr. No. 4178/G/2018/KSCADC dt.19/12/2018 following the discussion with their officials on 08/12/2018. A work order was issued by KSCADC on 17.11.2021.

2.0 OBJECTIVES

The specific objectives of the work are defined as below.

- Investigation of shoreline erosion rate along the specified coastal stretch (about 20km long stretch in the Vipin area north of Cochin port entrance) through satellite imageries over the past 2 decades.
- To study annual wave climate off the Vipin coastal stretches through detailed numerical modelling validated through measurements off Cochin coast.
- Field investigations of shoreline profile, beach profiles, sediment characteristics and littoral current.
- Designing suitable coastal protection scheme at sub stretches in the Ernakulam district, Kerala with particular site-specific schemes. The sub stretches will be considered with sediment sub-cell concept and also, to facilitate the execution of the work in phases.
- Prediction of shoreline in the event of the construction of the proposed scheme in the future.
- Preliminary design of proposed sections keeping in consideration of environmental issues.

3.0 INTRODUCTION

The coastal stretch of Kerala is 590 km long, extending along the southwestern Indian peninsula. It is divided into 9 districts (Thiruvananthapuram, Kollam, Alappuzha, Ernakulam, Thrissur, Malappuram, Kozhikode, Kannur, Kasaragod) along the coast; the present study area is situated in the Ernakulam district as shown in **Fig. 1**. About 420 km of coastal stretch is protected by hard structures (such as sea walls, groyne field, etc.) (Sundar and Murali, 2007). The region has three distinct seasons, the pre-monsoon from February to May, the southwest monsoon from June-September, and Post monsoon from October to January, annually. The normal tide variation in Kerala is between 0.9m in the south and 1.8m in the north (Thiruvenkatasamy and Girija, 2014). The net annual longshore sediment transport was reported to vary between 0.32 x 10^5 m^3 and 2.3 x 10^5 m^3 along the Kerala coast with the net transport direction being pre-dominantly northerly for most locations along with Kerala. The Kerala coast faces high erosion by various natural processes such as wind, currents, and waves, the sediment moves along the shore, which changes the shoreline (Mallik et al., 1987). The longshore currents are predominantly northerly during the fair season, whereas it is mostly towards the south during the monsoon season.

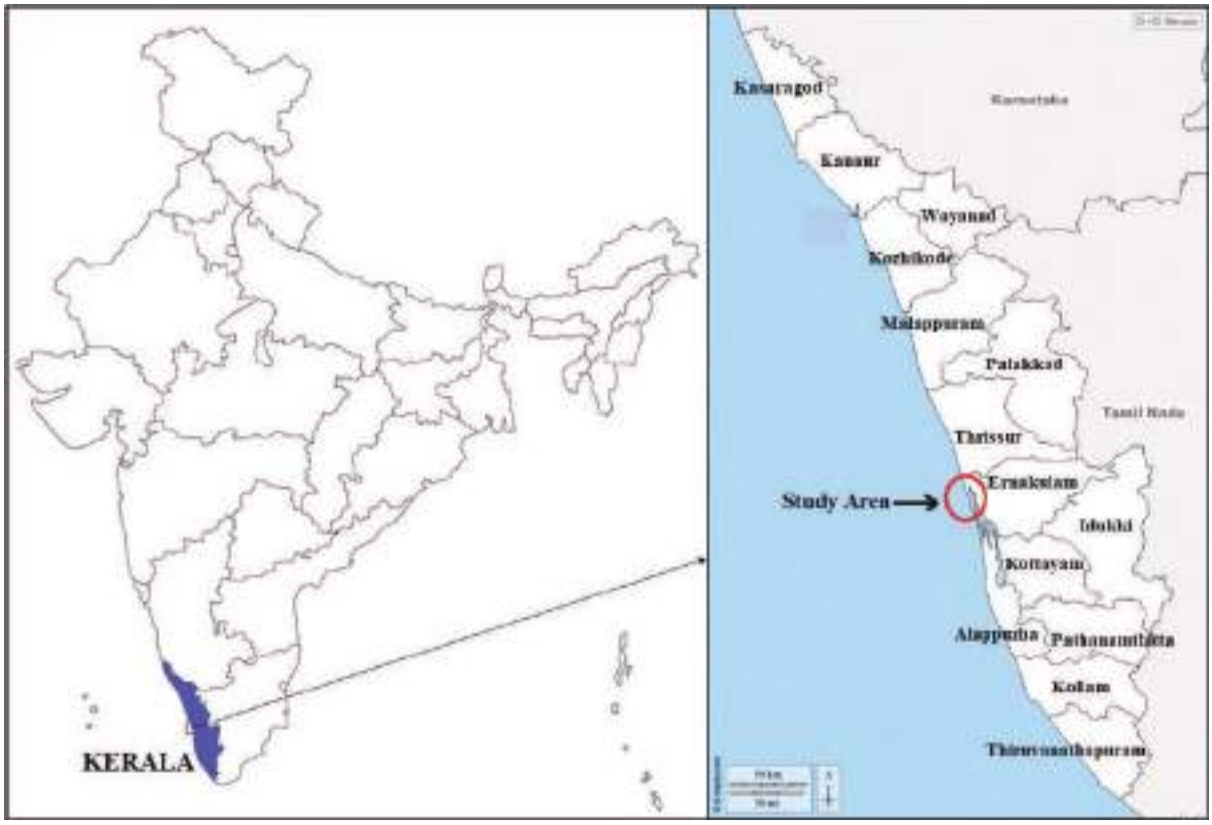


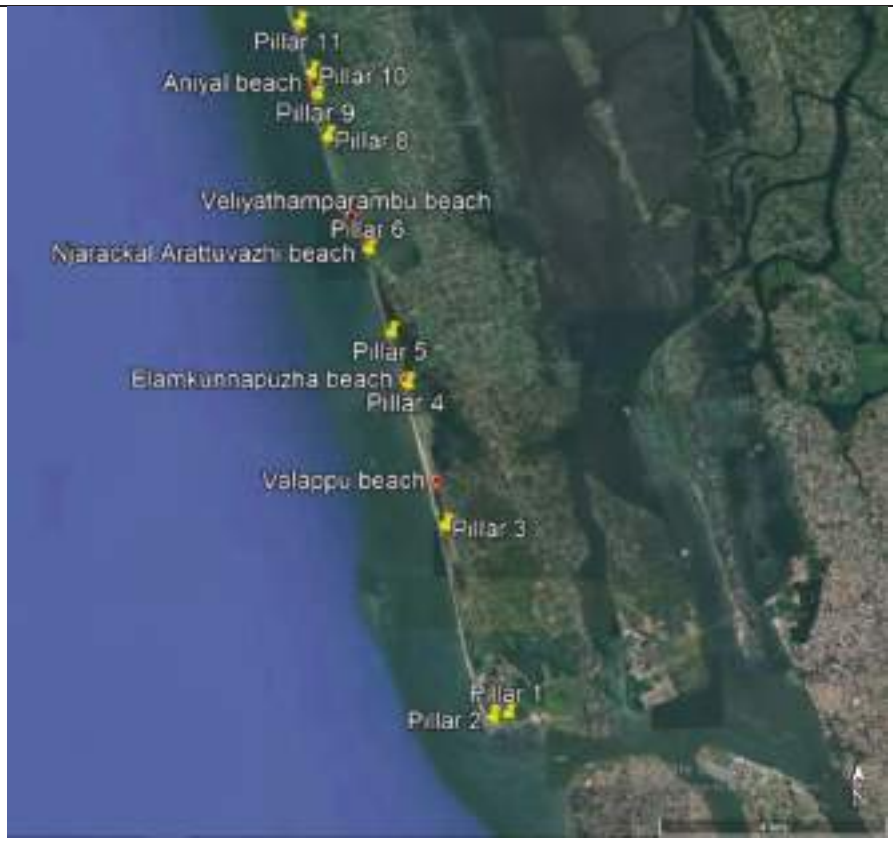
Fig.1 Study Area

The factors for shoreline changes along the coast are both natural and anthropogenic. For studying the long-term stability of any coast, it is necessary to conduct a detailed analysis of the shoreline changes over the period under consideration, because the shoreline being dynamic is susceptible to changes by various driving factors.

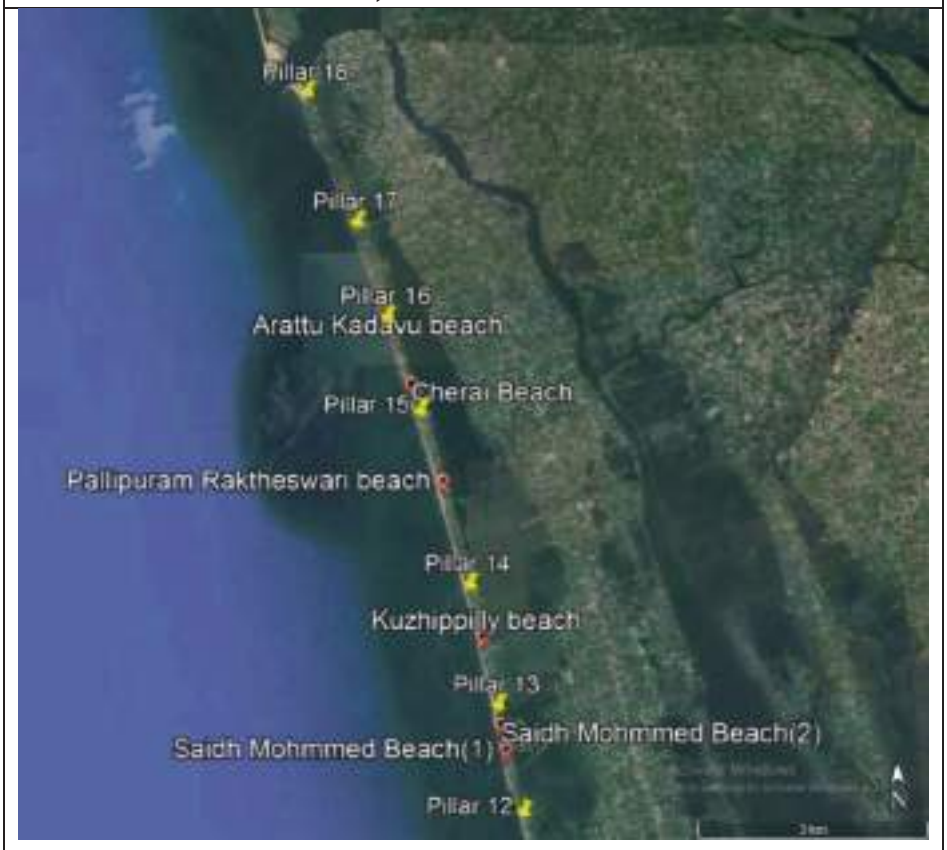
4.0 PRELIMINARY INVESTIGATION

A site visit was carried out by Prof. V. Sundar and Prof. S.A. Sannasiraj of IIT Madras along with Mr. Sheik Parith, Managing Director of Kerala State Coastal Area Development Corporation Limited (KSCADC) and his officials on 16 December 2021. This was to identify the vulnerable sites experiencing erosion. Although the water logging was present at several stretches of the coast due to the monsoon spell, the site visit was successfully completed and the details of which was reported by IITM to KSDAC during the last week of Dec 2021.

For the study, the analysis of coastal changes along the Ernakulam coastal district sites is identified and marked. The stretch is noted from LNG Petronet to Munambam training wall, spanning for about 24 km. The location has been marked as pillar 1-18 as shown in **Fig 2** and the location between pillars is marked as cell 1-17 as shown in **Table 1**. The shore change at the Kerala coast is dynamic and comparing the long-term shoreline change using multi-dated satellite images gives a clear view of the erosion/accretion rates. The shoreline changes have been observed for the identified cells encompassing open coasts, groyne protected structures, fishing hamlets, etc.



a) From Pillar 1-11



b) From Pillar 12-18

Fig.2 Location of sediment cells

Cells	Pillars	Shore Length (km)	Type of structure	Erosion/ Accretion	Site visit identified locations	Latitude Longitude of cells	Sea Wall/ Groyne (km)	Open Coast (km)
Cell 1	Pillar 1-2	0.37	South of LNG jetty	High Accretion	-	9°58'27.17" N 76°13'33.13" E	-	0.37
Cell 2	Pillar 2-3	3.4	Single Training Wall	High Erosion	-	9°59'22.28" N 76°13'13.05" E	-	3.4
Cell 3	Pillar 3-4	2.5	End of IOCL LPG Terminal	High Erosion	Valappu	10° 1'4.17" N 76°12'50.23" E	-	2.5
Cell 4	Pillar 4-5	0.93	Sea Wall	-	Elamkunnapuzha	10° 1'48.84" N 76°12'35.37" E	0.93	-
Cell 5	Pillar 5-6	1.49	Sea Wall	-	Njarackal Arattuvazhi	10° 2'30.61" N 76°12'24.01" E	1.49	-
Cell 6	Pillar 6-7	0.25	Single Groyne and sea wall	Moderate Erosion	-	10° 2'53.63" N 76°12'18.05" E	0.13	0.12
Cell 7	Pillar 7-8	1.9	Sea Wall	-	Veliyathamparambu	10° 3'22.67" N 76°12'3.43" E	1.9	-
Cell 8	Pillar 8-9	0.75	Groyne Field	Moderate Erosion	-	10° 4'7.84" N 76°11'51.43" E	0.75	-
Cell 9	Pillar 9-10	0.4	Open Beach	Moderate Accretion	Aniyal beach	10° 4'25.19" N 76°11'47.40" E	-	0.4
Cell 10	Pillar 10-11	0.88	Open beach, Narrow strip	Moderate Accretion & Erosion	-	10° 4'46.04" N 76°11'42.43" E	0.44	0.44
Cell 11	Pillar 11-12		Sea wall	-	-	10° 5'10.93"N 76°11'34.49"E	0.84	-
Cell 12		1.4			Saidh Mohammed 1	10°5’47.13” N 76°11’24.28” E	0.89	-

	Pillar 12-13		Open Coast, Seawall & Groyne Field	Moderate Erosion & accretion	Saidh Mohammed 2	10°5’57.76” N 76°11’21.90” E	-	0.51
Cell 13	Pillar 13-14	1.62	Open Coast	Moderate Erosion	Kuzhippilly beach	10°6’34.49” N 76°11’14.56” E	-	1.62
Cell 14	Pillar 14-15	2.35	Open Coast, Seawall	Moderate Erosion	Pallipuram Raktheswari	10°7’40.55” N 76°10’57.99” E	0.35	2
Cell 15	Pillar 15-16	1.3	Open coast	Moderate Erosion	Cherai	10° 8'32.37" N 76°10'41.29" E	0.84	0.46
Cell 16	Pillar 16-17	1.31	Seawall & Open coast	Moderate Erosion	Arattu Kadavu	10° 9'12.40" N 76°10'26.74" E	1.33	-
Cell 17	Pillar 17-18	1.85	Sea Wall	-	-	10°10'2.82" N 76°10'8.43" E	1.85	-

Table.1 Location description of Cells and Pillars

5.0 DSAS METHODOLOGY

The science of shoreline mapping has significantly evolved over the years to reduce the uncertainties involved in measurement and data processing. The remotely collected data from satellite imagery, such as the Google Earth timeline imagery, can furnish valuable preliminary data to understand the dynamic behaviour of shoreline variation in a localized stretch. The comprehensive effect of shoreline changes can be understood by employing statistical approaches (Dolan et al., 1991). The methodology adopted for the present study includes data collection, shoreline demarcation, and shoreline change rate calculation. Multi-temporal satellite cloud-free data of Landsat TM and ETM sensors acquired from 2008 to 2020 along the Kerala Coast. The data source was used to demarcate the shoreline change using ArcGIS 10.6.1 software using the Digital shoreline analysis system technique. For each shoreline extraction, the high-water line boundary is considered as a shoreline proxy. The shoreline data analysis has been projected in **Fig 3**.

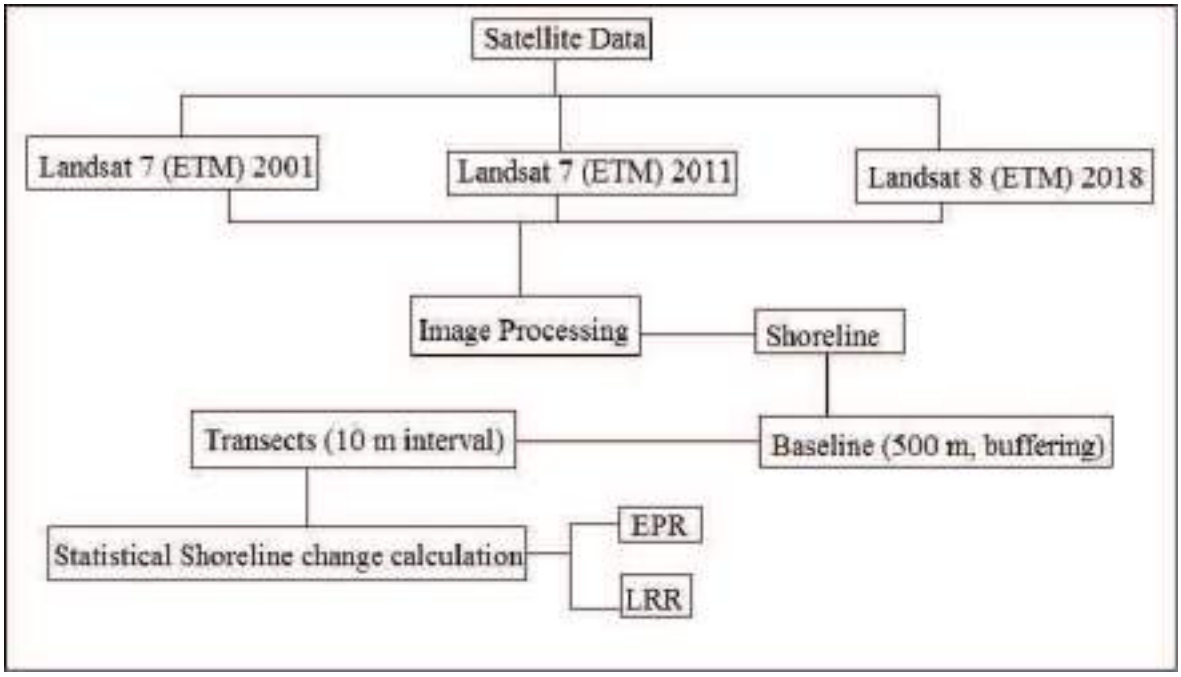


Fig.3 Flow chart for methodology

5.1 DSAS

To select the optimal technique, a revalidation study between the extracted shorelines and the corresponding physical measurements has been carried out in ArcGIS 10.6.1 for the three segments at different seasons. These are analyzed using the DSAS tool. The tool is used to

calculate the rate of shoreline movement and the changes. The DSAS is executed in five steps: (1) demarcation of shoreline; (2) baseline creation; (3) transects generation; (4) computation of distances between baseline and shorelines at each transect; and, (5) computation of rate of shoreline change.

The transect line is generated for a length of 100m from the baseline to the shoreline. The spacing between the transects is uniformly maintained at 5m and 10m intervals according to site conditions. The extracted shoreline from each year that intersects at each of the transects has been used for calculating the shoreline change rate, (i.e.) the difference between the extracted and the observed shoreline is calculated along transects perpendicular to the baseline.

5.2 End Point Rate

The End Point Rate (EPR) is calculated by dividing the shoreline change by the time elapsed between the oldest and the most recent shoreline. The major advantages of the EPR are the ease of computation and the minimal requirement of only two shoreline data. The extracted digital shorelines then were superposed to identify the shoreline change over the number of years. When the shoreline keeps fluctuating about a mean point, i.e., accreting and eroding throughout different seasons of the year, the observed value of the end point rate would be a minimum.

$$\text{EPR} = \text{distance in meters/time between the oldest and most recent shoreline} \quad (1)$$

5.3 Linear Regression Rate

A linear regression rate of change statistics is determined by fitting a least-squares regression line to all shoreline points chosen for the study. The regression line is placed such that the sum of the squared residuals (determined by squaring the offset distance of each data point from the regression line and adding the squared residuals together) is minimized. The linear regression rate is the slope of the regression line.

Change Rate Calculation

In this study, changes in the shoreline position are computed using four data analysis techniques (i.e., EPR and LRR). The EPR is evaluated by dividing the distance between any two shorelines by the number of years between them. This method is enormously prevalent in the calculation of the rate of movement of shoreline change, as it is widely used by different coastal researchers.

$$EPR = \frac{L_1 - L_2}{t_1 - t_2} \quad (2)$$

wherein, L_1 and L_2 are the distances separating the shoreline and baseline; t_1 and t_2 are the dates of the position of the two shorelines considered. The second method adopted is through LRR, which consists of fitting a least-squares regression line to multiple shoreline position points for a particular transect (Mahapatra et al., 2014). The shoreline change rate along each transect for all periods is computed by plotting the points where the shorelines are intersected by transects and calculating the linear regression equation,

$$L = b + mx \quad (3)$$

where, L represents the distance (m), from the baseline, x is the shoreline date intervals (years), and m is the slope of the fitted line (m/year) (i.e., represents the shoreline change rate, LRR), and b is the y-intercept (**Fig. 4**).

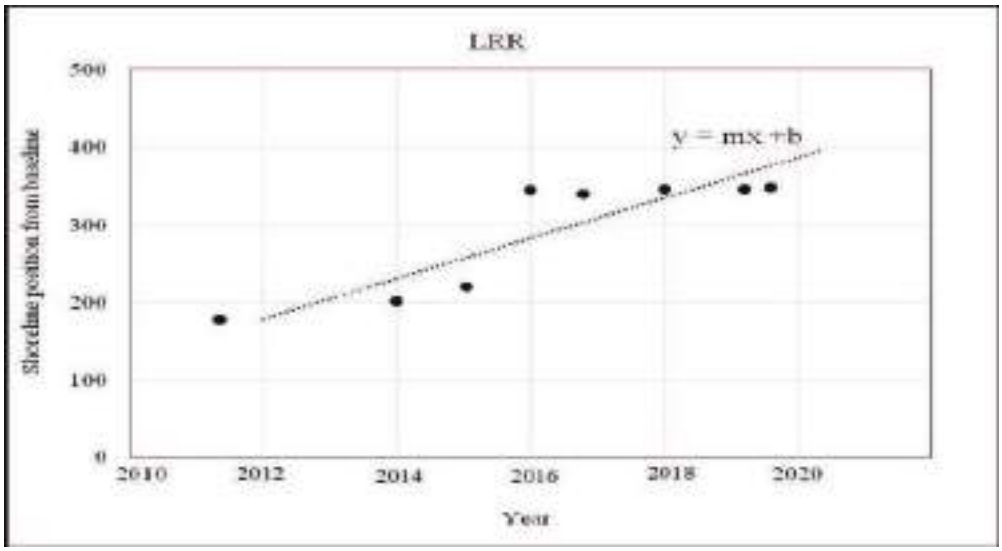


Fig.4 Linear Regression Rate of Shoreline changes

5.4 Results and Discussion

5.4.1 Cell 1-2 (Pillar 1-2-3)

Prior to the construction of Petronet LNG jetty

The coastal stretch (see **Fig. 5a**) covers Petronet LNG, IOCL, BPCL; and the area is assessed before the construction of structures. The Petronet LNG limited was constructed in 2009. The shoreline changes have been observed for 2002, 2005, 2006 and 2007. The length of the shore is 3.8km, the baseline buffer is 150m from the shoreline and the spacing between the transects is 10m.

According to EPR and LRR, the rate of erosion is high in the north (i.e. at end of IOCL facility), and the rate of accretion is high in the south region (near Petronet LNG). The maximum rate of erosion is -20.3m/yr and the maximum rate of accretion is 10m/yr as shown in **Fig.5b**.

Fig.5a Cell 1-2 (Pillar 1-2-3)

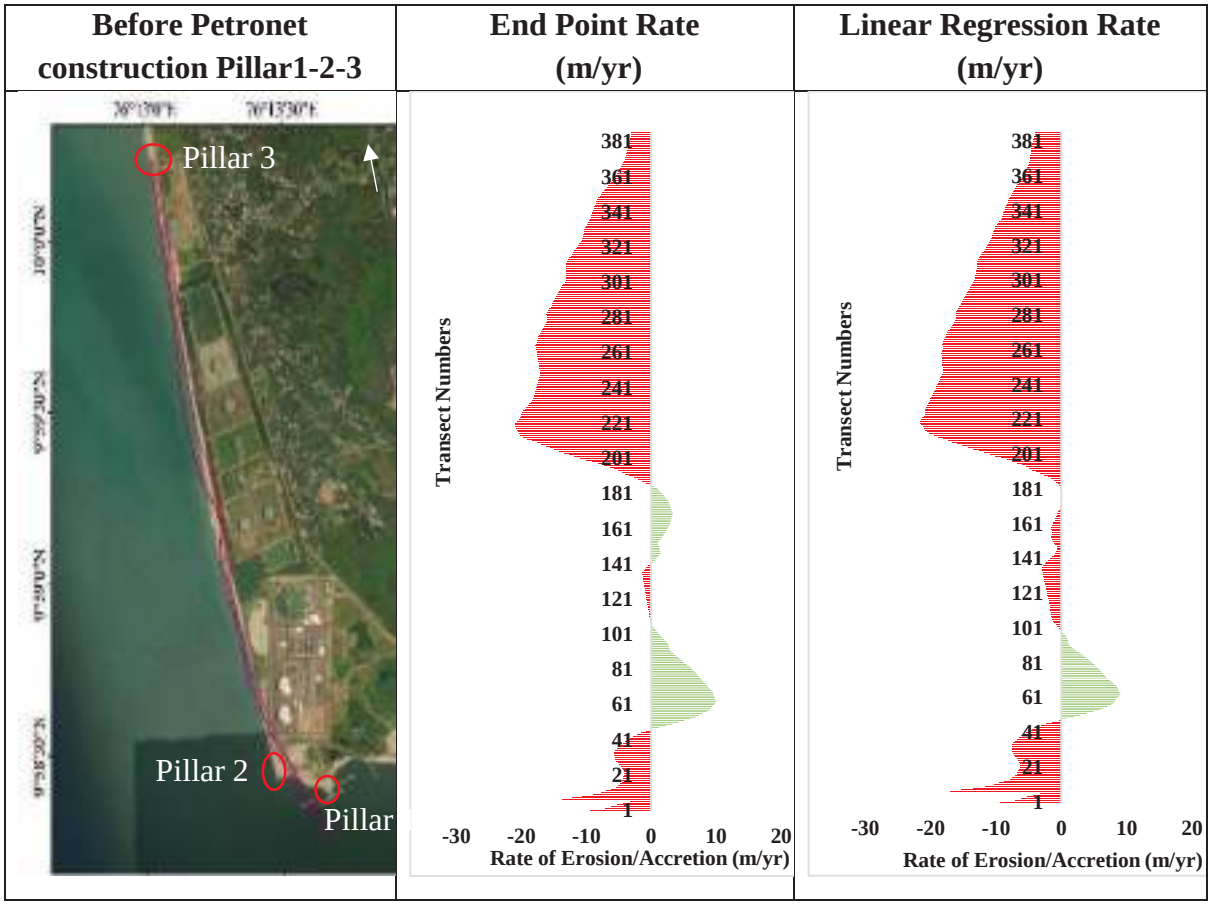


Fig.5b Results of Cell 1-2 (Pillar 1-2-3)

5.4.2 Cell 1 (Pillar 1 - Pillar 2)

The shoreline changes have been observed at the inlet of the channel. The Petronet jetty (constructed in 2009 and later expanded in 2010) is perpendicular to the inlet boundary, at an offset of 300m. A training wall was constructed at the entrance of the inlet in 2011. The shoreline changes for cell 1 have been observed for 2011-2020 (10 years). The length of the shore is 0.37 km (see **Fig 6a**); the baseline buffer is set 150m from the shoreline and the spacing between the transects is 5m.

According to EPR and LRR, the rate of accretion is high near the LNG jetty and the rate of erosion is low near the training wall. The maximum rate of accretion is 9.3 m/yr and the maximum rate of erosion is -1.7 m/yr as shown in **Fig.6b**.

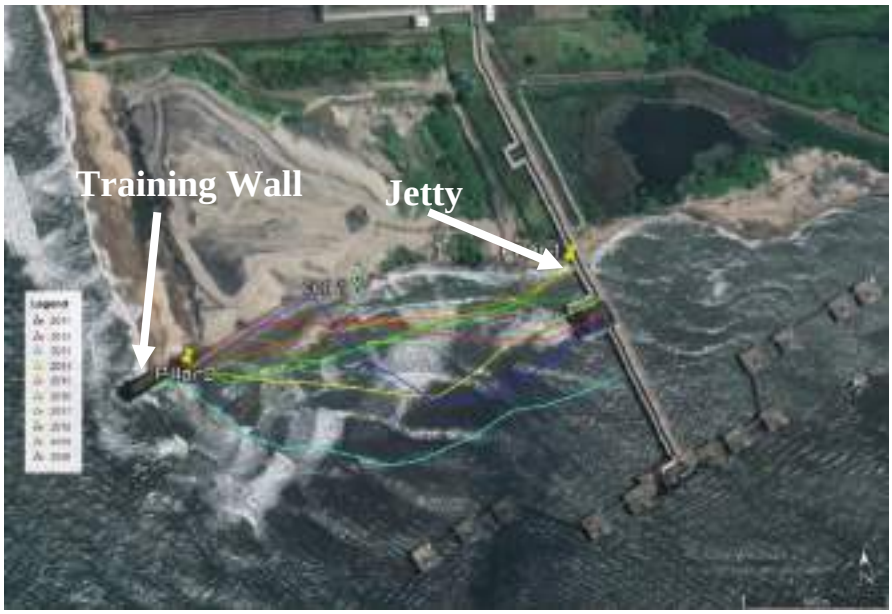
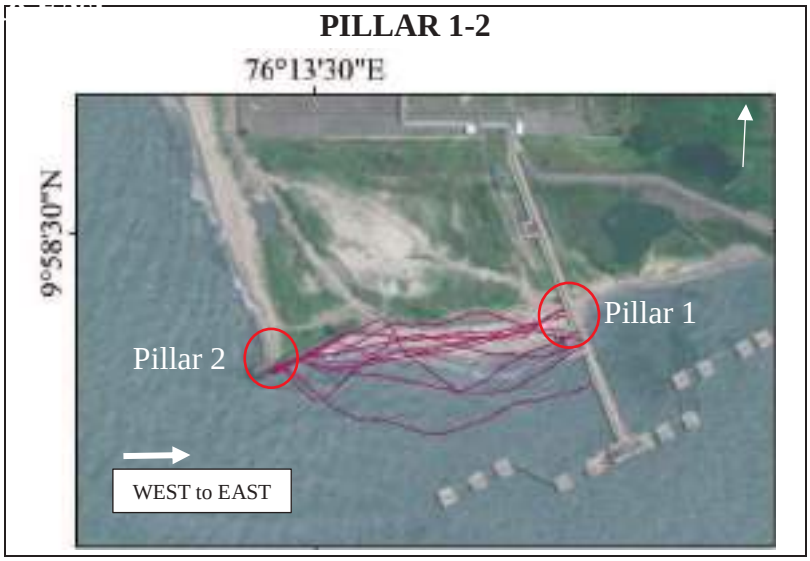


Fig.6a Cell 1 (Pillar 1 - Pillar 2)



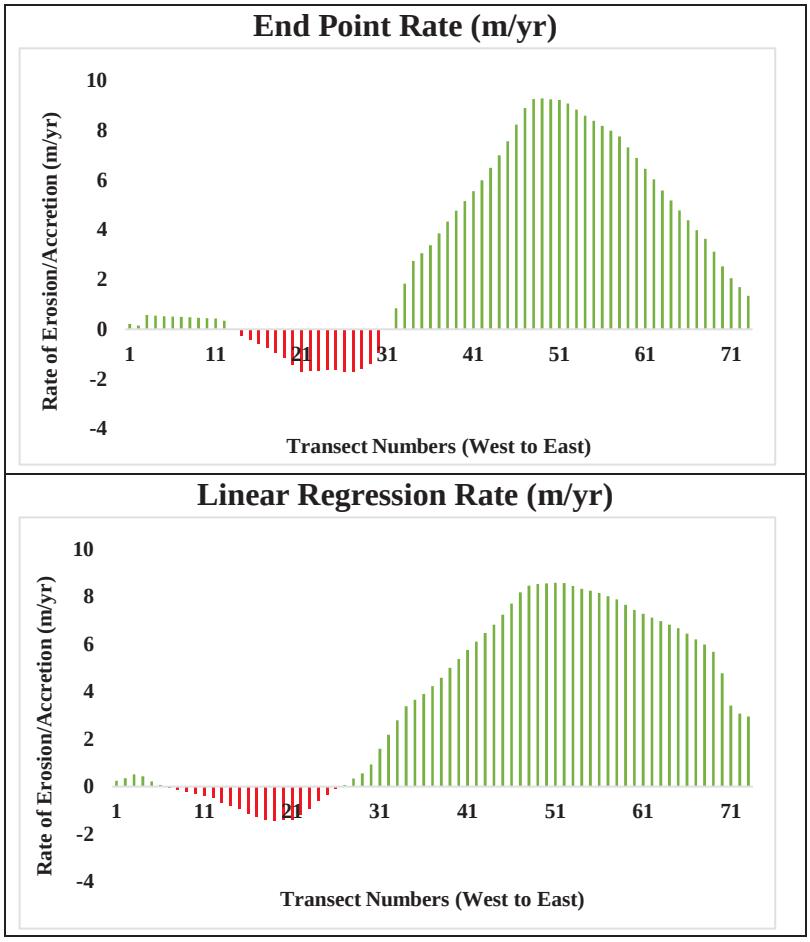


Fig.6b Results of Cell 1 (Pillar 1 - Pillar 2)

5.4.3 Cell 2 (Pillar 2 - Pillar 3)

After construction of Petronet jetty

The shoreline study area covers the coastal stretches of Petronet LNG, BPCL, and IOCL facilities (see **Fig 7a**.) The shoreline changes were observed for 2012 – 2020 (9 years), for a shore stretch of 3.4 km. The baseline buffer is set 100m from the shoreline and the spacing between the transects is 10m.

According to EPR and LRR, the rate of erosion is high at the south (near Petronet LNG and BPCL facilities) and the accretion is moderate at the north (near the end of IOCL). The maximum rate of erosion is -8.16 m/yr, for about 2km from the southern end and moderate accretion at north up to 2.4 m/yr as shown in **Fig 7b**.

Fig.7a Cell 2 (Pillar 2 - Pillar 3)

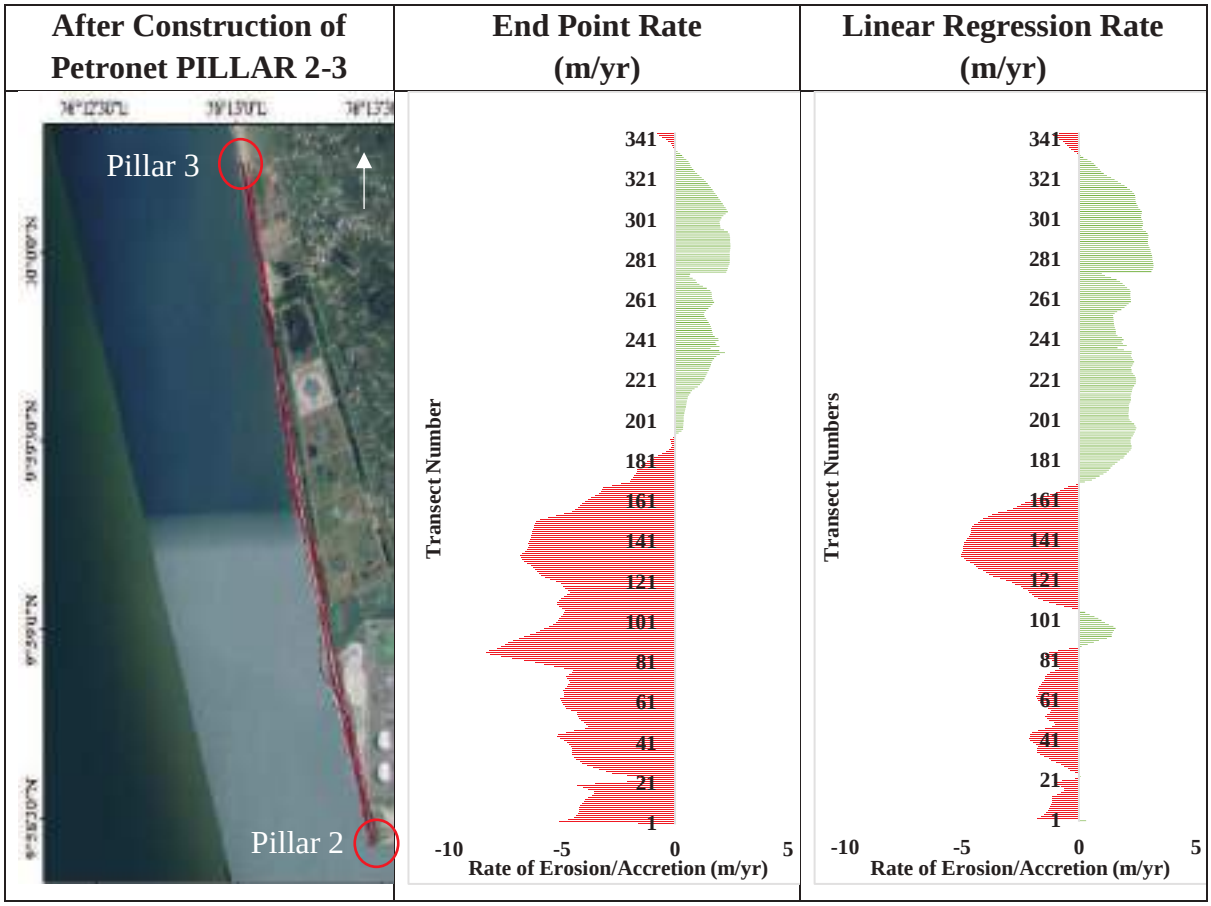


Fig.7b Results of Cell 2 (Pillar 2 - Pillar 3)

5.4.4 Cell 3 (Pillar 3 - Pillar 4)

Valappu beach

This stretch extends for 1.5 km and is observed to have a beach width of about 25m and it is located immediately north of the IOCL facilities. The northern and southern coastal stretch from the Valappu beach beach are shown in **Fig.8**. The beach slope is found to be very steep and it is understood that the beach width oscillates depending on the wave climate/seasons. The cross-shore sediment transport is found to be significant during south-west monsoon season. Valappu beach beach is identified to be an active tourist attraction and thus the aesthetics needs to be preserved. The probable solution to be examined could be a submerged reef in the nearshore waters or a T-groynes which is to be decided after a detailed study.

Fig.8a A view of the North of Valappu beach

Fig.8b A view of the South of Valappu beach

Elamkunnapuzha beach

This stretch is located north of Valappu beach. The shoreline in the vicinity of this beach is protected by rubble mound sea wall (**Fig. 9**) which has settled marginally due to severe erosion. This is certainly due to the protrusion of the landmass into the ocean serving as a littoral barrier leading to erosion on its southern end, as the net littoral drift at this stretch is likely to be towards the south.

Fig.9 A view of Elamkunnapuzha beach (North and South)

The shoreline changes are observed for the area after the commissioning of the IOCL and LPG import yard. The shore length is 2.5km, which includes a beach area, i.e., Valappu beach at the south and Elamkunnapuzha beach at the north (see **Fig 10a)**. The shoreline changes have been observed from 2011-2012 and 2014-2020 (9 years). The baseline buffer is 100m from the shoreline and the spacing between the transects is 10m.

According to EPR and LRR, almost the entire stretch experiences active erosion with the maximum rate of erosion at -11.15 m/yr as shown in **Fig 10b**. The rate of accretion is less than 5% in the area as per EPR.

Fig.10a Cell 3 (Pillar 3 - Pillar 4)

PILLAR 3-4	End Point Rate (m/yr)	Linear Regression Rate (m/yr)

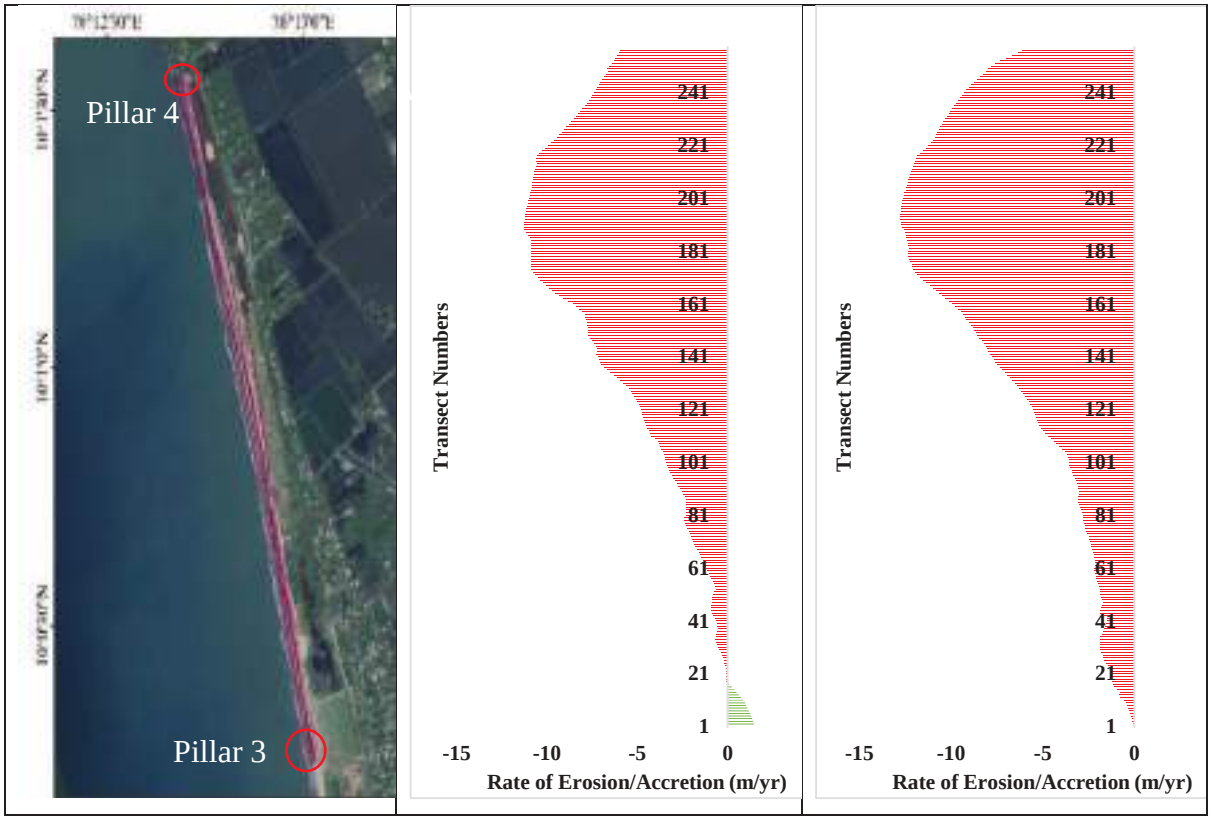


Fig.10b Results of Cell 3 (Pillar 3 - Pillar 4)

5.4.5 Cell 4 (Pillar 4 - Pillar 5)

This stretch is protected by a seawall **(no immediate action required).**

5.4.6 Cell 5 (Pillar 5 - Pillar 6)

This stretch is protected by a seawall. **(No immediate action required).**

5.4.7 Cell 6 (Pillar 6 - Pillar 7)

Njarackal Arattuvazhi beach

The existing beach is protected with a seawall structure, which is serving its purpose with occasional overtopping. The toe of the seawall needs to be strengthened after accessing the present status of the profile of this seawall. Views of the seawall on the north and south of the location are projected in **Fig.11**.

Fig.11a View of Njarackal Arattuvazhi beach (Northern side)

Fig.11b View of Njarackal Arattuvazhi beach (Southern side)

Veliyathamparambu beach

The 200m stretch of this beach is located in between two existing groynes designed by IITM. The views of the stretch north and south from the Veliyathamparambu beach are shown in **Fig 12**.

The two groynes (North one constructed as the groyne, whereas the southern groyne has been protruding as an extension of an existing sea wall) have facilitated the formation of a beach width of about 30m wide. The head section of both the groynes is damaged which needs rehabilitation. At present, it is stated by locals that about 50 boats are using this beach as a landing facility and are pleading for its sustainability. One possible solution could be an extension of both the existing groynes or to provide a T-section at their tips after the evaluation of the littoral drift.

Fig.12a Views of Veliyathamparambu beach (North)

Fig.12b View of Veliyathamparambu beach (South)

The Njarackal Arattuvazhi beach is located at the south (near Pillar 6) and Veliyathamparambu beach at the north (immediately after Pillar 7) (see **Fig.13a**). The shoreline changes have been observed from 2011 – 2020 (10 years) for a 0.25 km stretch. The baseline buffer is 100m from the shoreline and the spacing between the transects is 5m. According to EPR and LRR, the rate of erosion is low (-0.2 m/yr) as shown in **Fig.13b.**

Fig.13a Cell 6 (Pillar 6 - Pillar 7)

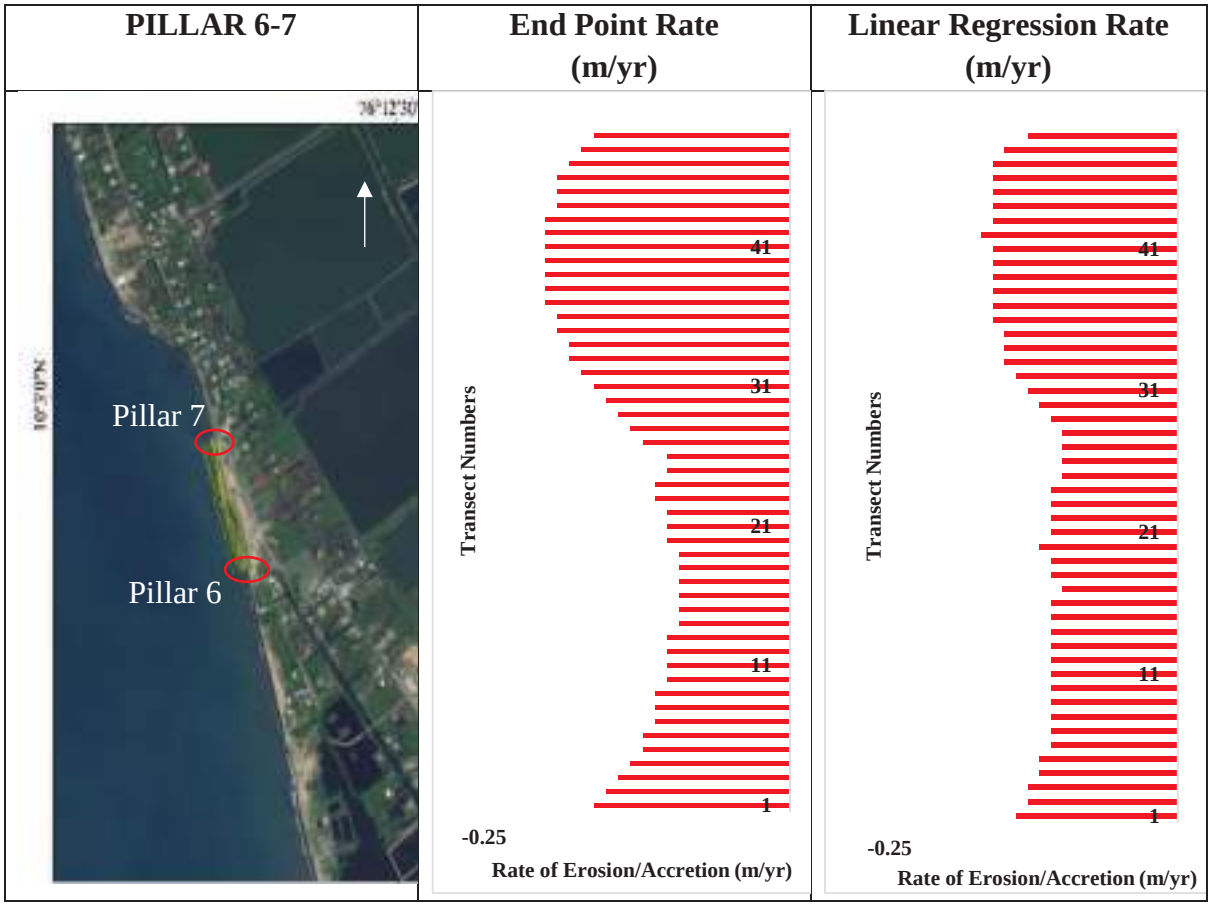


Fig.13b Results of Cell 6 (Pillar 6 - Pillar 7)

5.4.8 Cell 7 (Pillar 7 - Pillar 8)

This stretch is protected by a seawall. **(No immediate action required).**

5.4.9 Cell 8 (Pillar 8 - Pillar 9)

This shoreline stretch covers an existing groyne field and an open coast (see **Fig 14a**); where the shoreline changes were observed from 2012-2018 & 2020) (8 years). The length of the shoreline considered is 0.75 km with a baseline buffer of 100m from the shoreline and the spacing adopted between the transects is 5m.

According to EPR and LRR, the rate of erosion is moderate at the north and low accretion is observed at the south. The maximum rate of erosion is -2.36 m/yr and the maximum rate of accretion is 1.5 m/yr as shown in **Fig.14b.**

Fig.14a Cell 8 (Pillar 8 - Pillar 9)

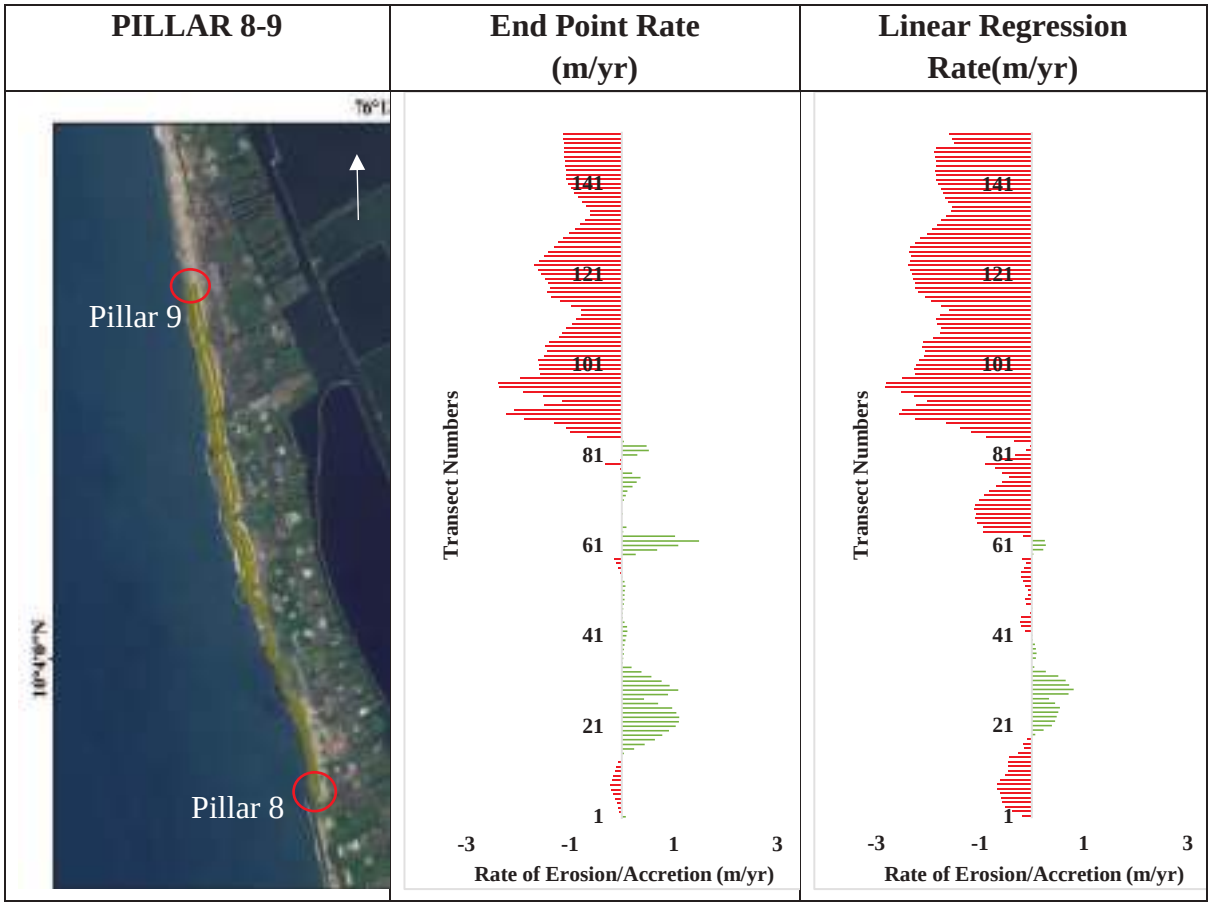


Fig.14b Results of Cell 8 (Pillar 8 - Pillar 9)

5.4.10 Cell 9 (Pillar 9-10)
Aniyal beach, Edavanakkad Grama Panchayat

A close site inspection of the seawall was hindered owing to heavy water logging around the coastal area. For about a 3 km stretch, the existing sea wall is damaged probably due to inadequate toe protection. Frequent overtopping results in under toe (Flow of water beneath the sea wall, which might be leading to the gradual settlement of sea wall). The probable solution could be strengthening the toe as well as preparing a trench immediately on the landward side of the sea wall and filling it with smaller stones to serve as a mattress. Views of the present status of the seawall; groynes along this stretch are projected in **Fig.15 &16** which needs to be rehabilitated.

Fig.15a A view of Aniyal beach Edavanakkad Grama Panchayat (North)

Fig.15b A view of Aniyal beach Edavanakkad Grama Panchayat (South)

Fig.16 A view of the damaged groyne Aniyal beach Edavanakkad Grama Panchayat (South)

The Aniyal beach, Edavanakkad Grama Panchayat is located within cell 9 (see **Fig.17a**). The shoreline changes for the 0.4 km stretch have been observed from 2010 to 2020with a baseline buffer at 100m from the shoreline and adopting a transect spacing of 5m.

According to EPR and LRR, the rate of accretion is moderate and the maximum rate of accretion is 2.63 m/yr as shown in **Fig.17b.**

Fig.17a Cell 9 (Pillar 9-10)

PILLAR 9-10	End Point Rate (m/yr)	Linear Regression Rate (m/yr)

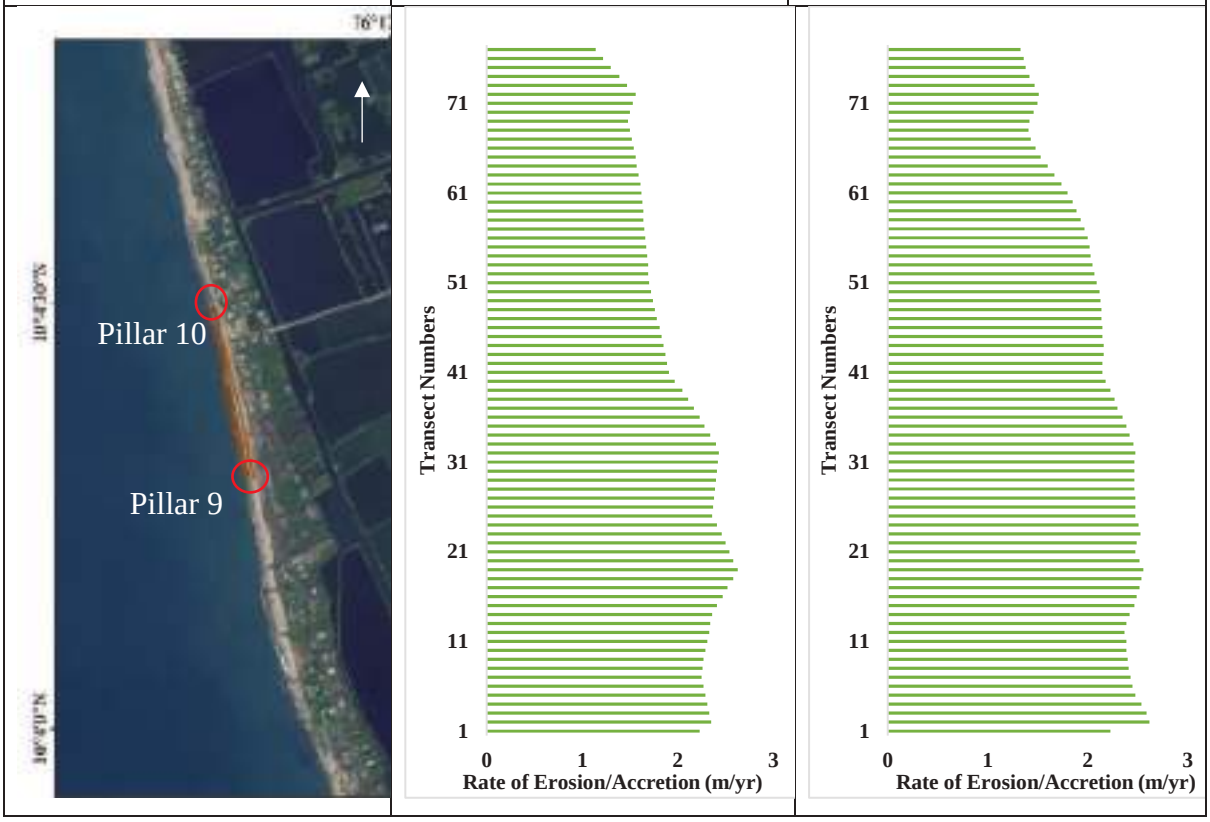


Fig.17b Results of Cell 9 (Pillar 9-10)

5.4.11 Cell 10 (Pillar 10-11)

The shoreline changes in this stretch (see **Fig.18a**) were observed for 2011-2018 & 2020 (9 years); the length of the shoreline is 0.88km. The baseline buffer is at 100m from the shoreline and the spacing between the transects is 5m.

According to EPR and LRR, the rate of erosion is moderate. The maximum rate of erosion is -2 m/yr at the mid-region as shown in. and **Fig.18b.**

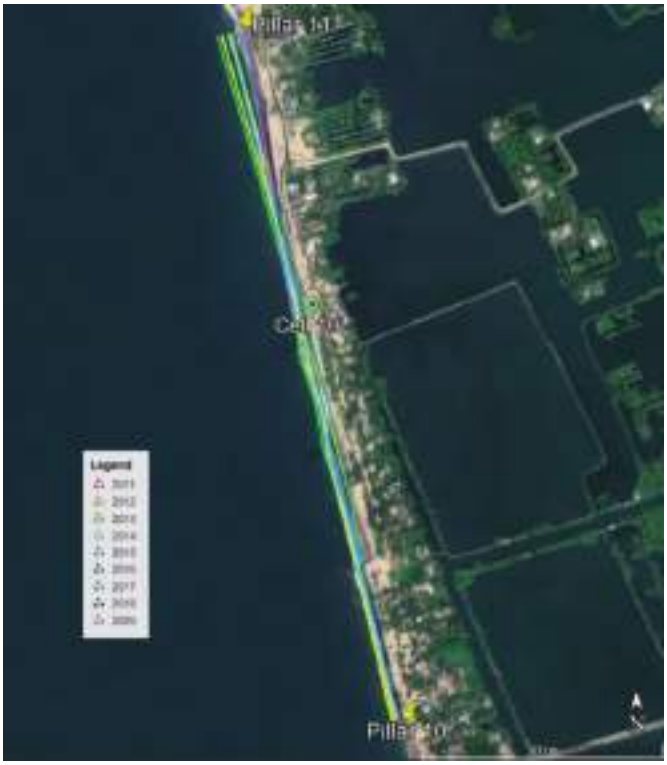


Fig.18a Cell 10 (Pillar 10-11)

PILLAR 10-11	End Point Rate (m/yr)	Linear Regression Rate (m/yr)

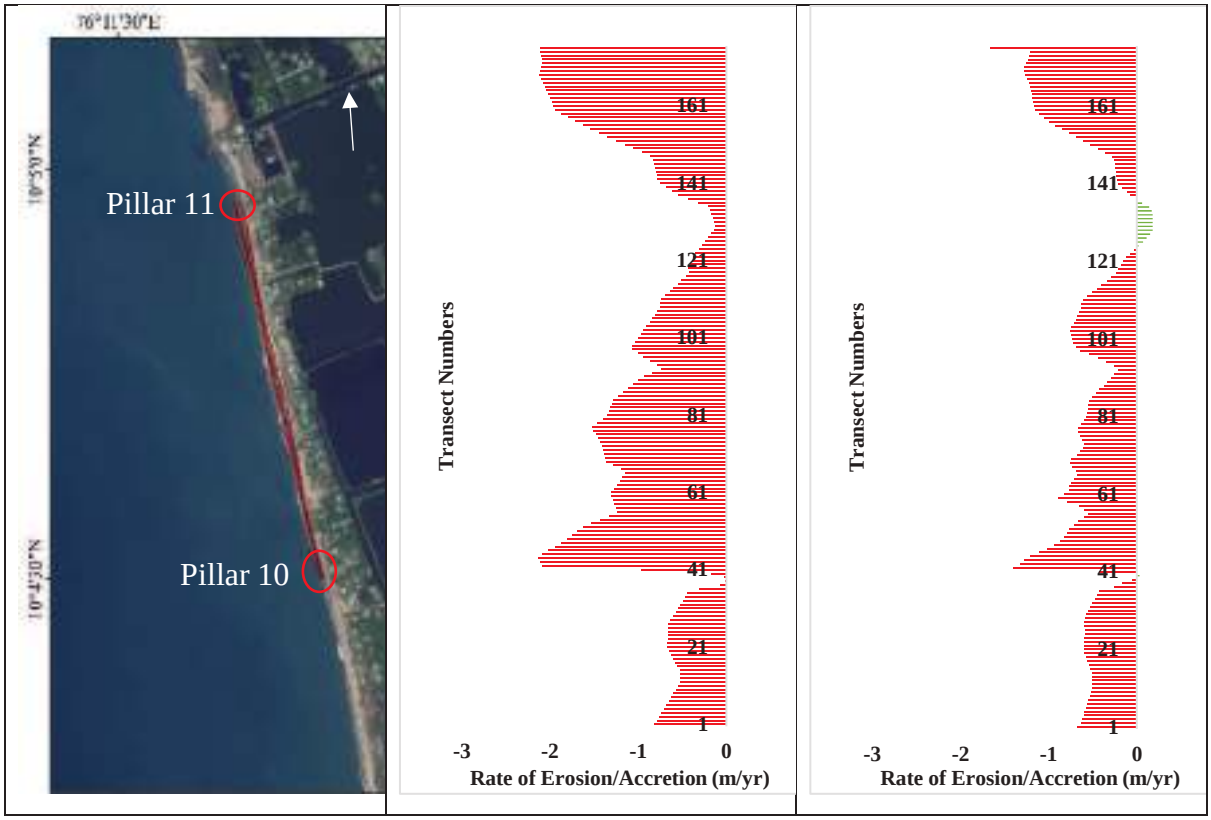


Fig.18b Results of Cell 10 (Pillar 10-11)

5.4.12 Cell 11 (Pillar 11-12)

This stretch is protected by a seawall. **(No immediate action required).**

5.4.13 CELL 12 (Pillar 12-13)

Saidh Mohammed beach (1)

This stretch has been protected with a groynes field designed by IITM which has been serving its purpose and has also encouraged the formation of beach on either side of each of the groynes. The beach thus formed has been serving as a buffer against the wave attack in the nearshore region. Although, the existing groyne head sections may require strengthening post a detailed inspection of the same. Views of Saidh Mohammed beach1 along the north and south of the site are shown in **Fig.19**.

Fig.19a View of Saidh Mohammed beach (1) (North)

Fig.19b View of Saidh Mohammed beach (1) (South)

Saidh Mohammed beach 2 (North-Nearby Sudhan mukk)

There is no immediate threat to this section of the coastal stretch, and thus no protection measures need to be commissioned with immediate effect.

The coastal stretch of cell 12 includes Saidh Mohammed beach (1) and Saidh Mohammed beach 2 (North-Nearby Sudhan mukk) (see **Fig.20a**). The erosion and accretion along the shore depend on season variation. The shoreline changes were observed from 2013-2018 & 2020 (7 years); the length of the shoreline is 1.42km. The baseline buffer is 100m from the shoreline and the spacing between the transects is 5m.

According to EPR and LRR, the maximum rate of erosion is -1.62 m/yr and the maximum rate of accretion is 1.6 m/yr as shown in **Fig.20b.**

Fig.20a Cell 12 (Pillar 12-13)

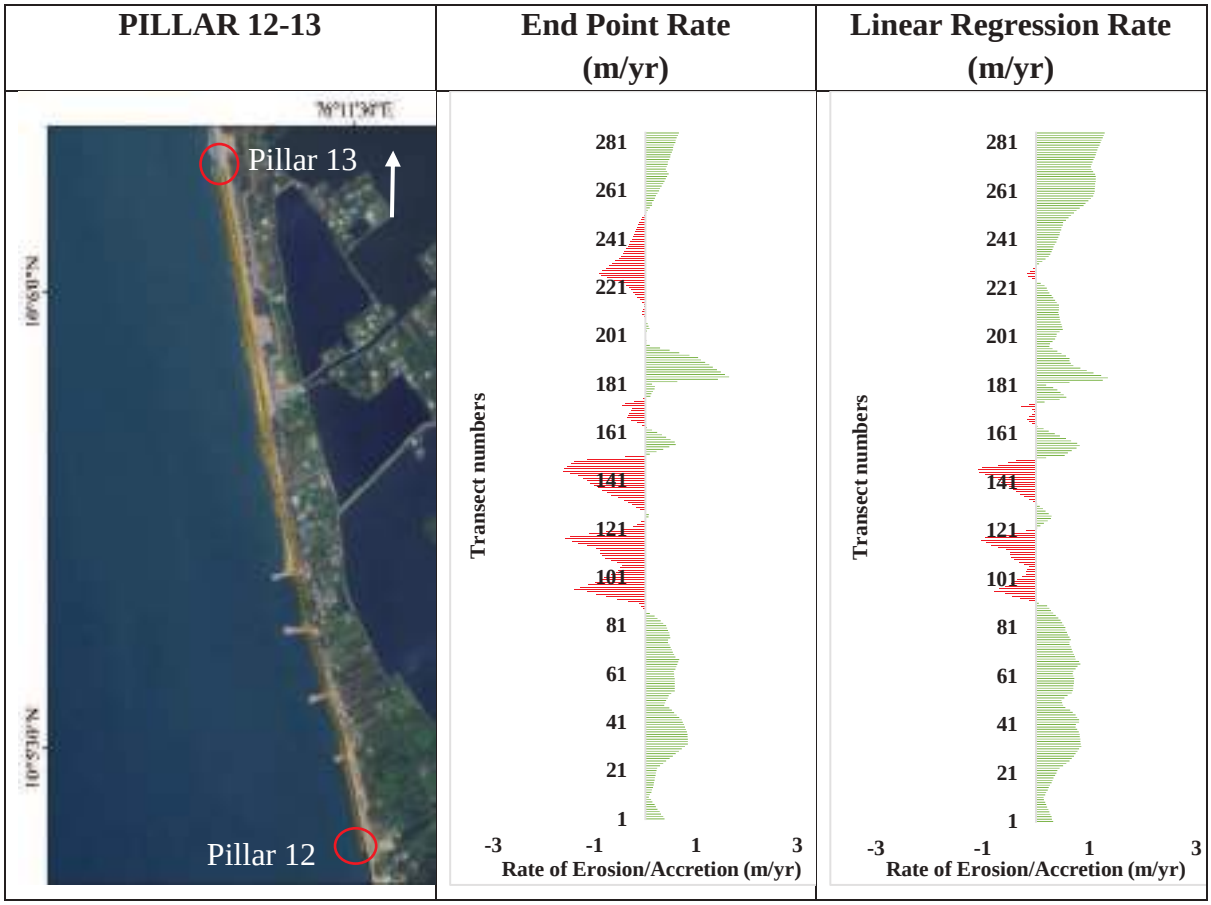


Fig.20b Results of Cell 12 (Pillar 12-13)

5.4.14 Cell 13 (Pillar 13-14)
Kuzhippilly beach

This coastal stretch is located south of the Pallipuram beach. Owing to the tourist interest in the Kuzhipilly beach it is mandated to enhance the formation beach and also to preserve the existing beach width, for which a detailed investigation requires to be conducted prior to arriving at a decision on the optimum coastal protection measure. The views of the stretch of the coast north and south of the site location are shown in **Fig.21**.

Fig.21a View of Kuzhippilly beach (North)

Fig.21b View of Kuzhippilly beach (South)

The coastal stretch considered for shoreline change assessment is shown in **Fig.22a.** The shoreline changes were observed for the years 2011-2018 & 2020 (9 years); the length of the shoreline is 1.62 km. The baseline buffer is 100m from the shoreline and the spacing between the transects is 5m.

According to EPR and LRR, the rate of erosion is moderate and the maximum rate of erosion is -1.44 m/yr as shown in **Fig.22b.**

Fig.22a Cell 13 (Pillar 13-14)

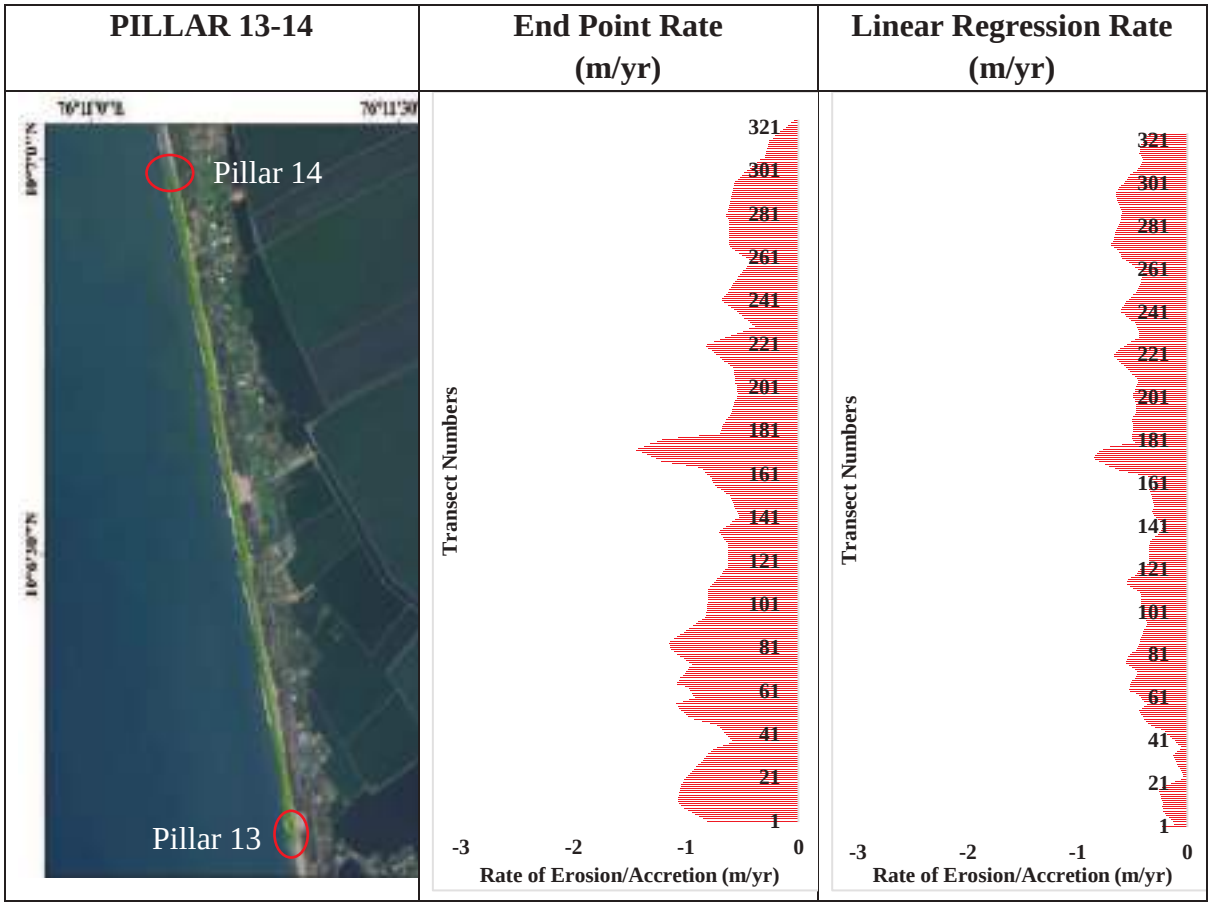


Fig.22b Results of Cell 13 (Pillar 13-14)

5.4.15 Cell 14 (Pillar 14-15)
Pallipuram Raktheswari beach

This beach is located south of Cherai beach. The local residents and authorities reported drastic dynamic changes in the beach width depending upon the seasons. This stretch is of prime importance as it attracts tourists. After a detailed investigation, the prospect of a submerged geo-tube or a groyne field (T-Groynes) will be examined and proposed accordingly. The view of the Pallipuram Raktheswari beach on its north and south are shown in **Fig.23**.

Fig.23a View of Pallipuram Raktheswari beach (North)

Fig.23b View of Pallipuram Raktheswari beach (South)

The shoreline changes of the said coastal stretch (see **Fig.24a**) have been observed for the years2013-2018 & 2020 (7 years); the length of the shoreline is 2.35 km. The baseline buffer is 100m from the shoreline and the spacing between the transects is 5m.

According to EPR and LRR, the rate of erosion is moderate and the maximum rate of erosion is -2.5m/yr as shown in **Fig.24b**.

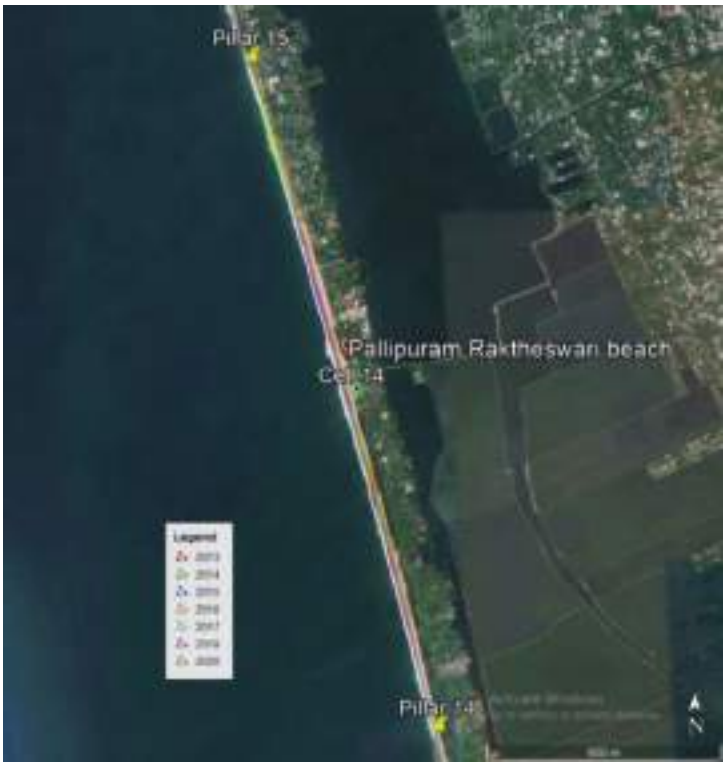


Fig.24a Cell 14 (Pillar 14-15)

PILLAR 14-15	End Point Rate (m/yr)	Linear Regression Rate (m/yr)

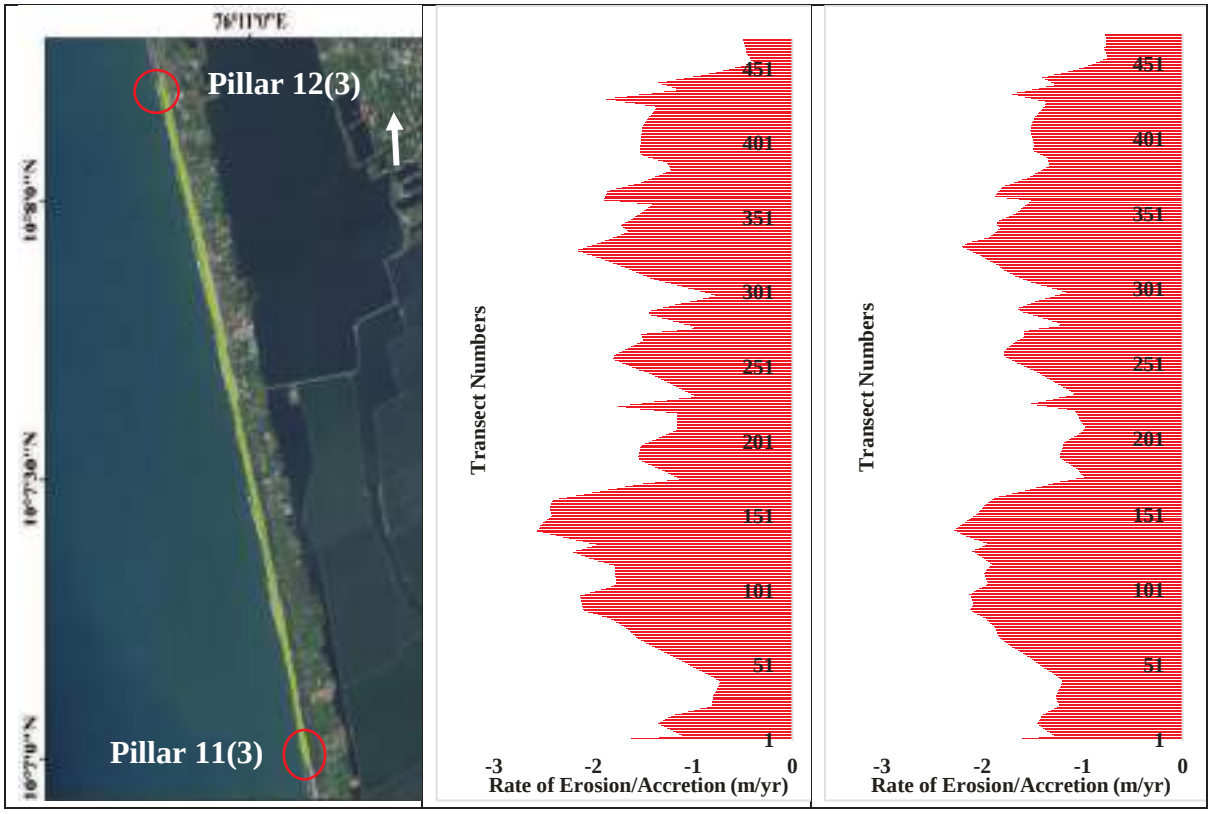


Fig.24b Results of Cell 14 (Pillar 14-15)

5.4.16 Cell 15 (Pillar 15-16)
Cherai beach

This beach is located on the northern side of Pallipuram Raktheswari beach. There is an urgent need to examine in detail the behaviour of this stretch as erosion is severe leading to the failure of the seawall, posing danger to the existing infrastructure. Furthermore, as stated earlier this stretch of coast is a tourist attraction and hence needs to be protected either with T-groynes or submerged geo-tube after a detailed investigation by IITM. Views of this stretch of the coast are provided in **Fig.25**.

Fig.25 Views of Cherai beach (North and South)

The shoreline changes at Cherai beach (see **Fig.26a**) have been observed for the years 2012-2018 & 2020 (8 years); the length of the shoreline is 1.3km. The baseline buffer is 100m from the shoreline and the spacing between the transects is 5m.

According to EPR and LRR, the rate of erosion is moderate along the entire stretch and the maximum observed rate of erosion is -2.69 m/yr as shown in **Fig.26b.**

Fig.26a Cell 15 (Pillar 15-16)

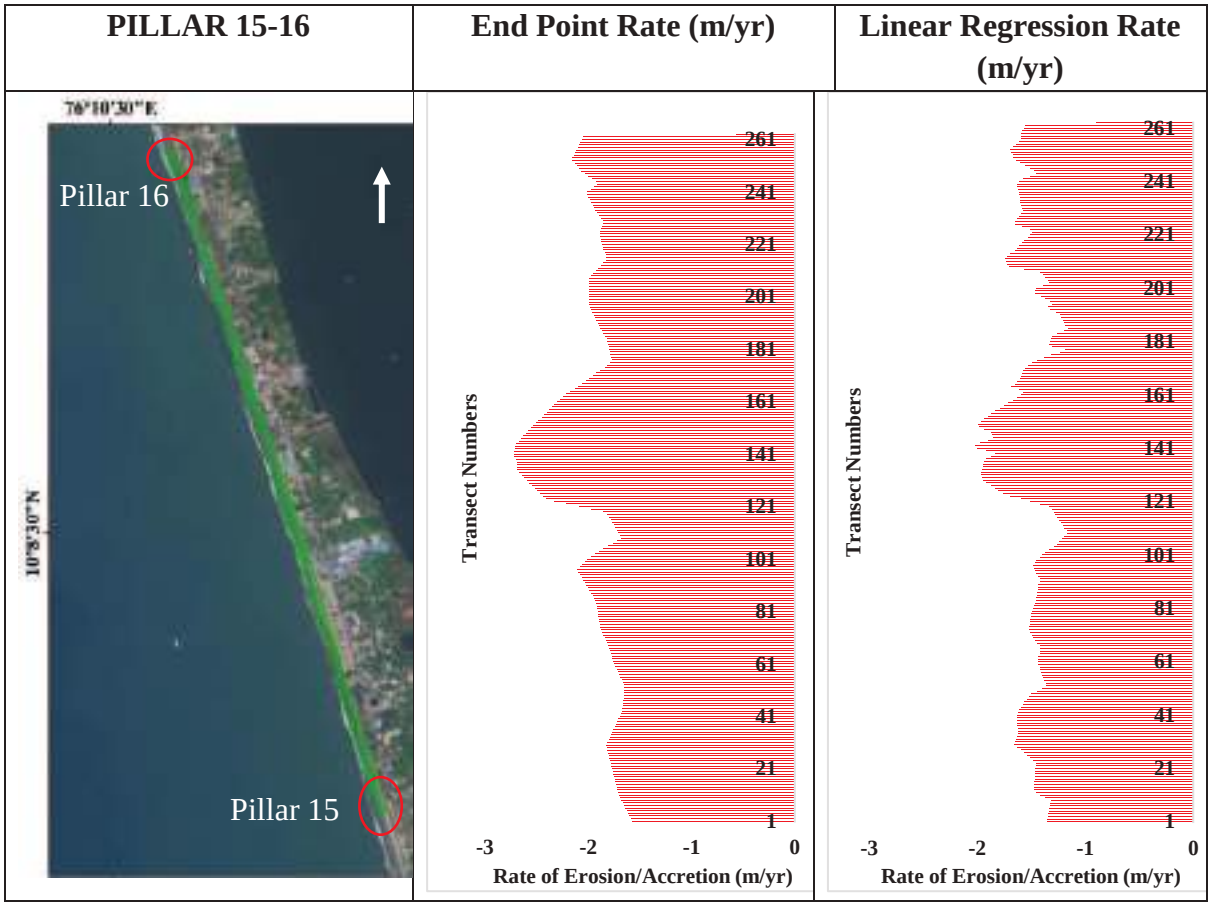


Fig.26b Results of Cell 15 (Pillar 15-16)

5.4.17 Cell 16 (Pillar 16-17)
Arattu Kadavu beach

This beach is located immediately north of Cherai beach. The beach front slope is quite flat which facilitates significant run-up during moderate and extreme wave climates in the nearshore region. The northern and southern stretches of the beach are shown in **Fig.27**. The Arattu Kadavu beach looks like an ideal location for a short groyne field.

Fig.27a View of Arattu Kadavu Beach (North)

Fig.27b View of Arattu Kadavu Beach (South)

The shoreline changes along the Arattu Kadavu beach (see **Fig.28a**) have been observed from the period of 2012-2018 & 2020 (8 years); the length of the shoreline is 1.33 km. The baseline buffer is 100m from the shoreline and the spacing between the transects is 5m.

According to EPR and LRR, the area tends to have moderate erosion. The maximum rate of erosion is -2.17 m/yr as shown in **Fig.28b**.

Fig.28a Cell 16 (Pillar 16-17)

PILLAR 16-17	End Point Rate (m/yr)	Linear Regression Rate (m/yr)

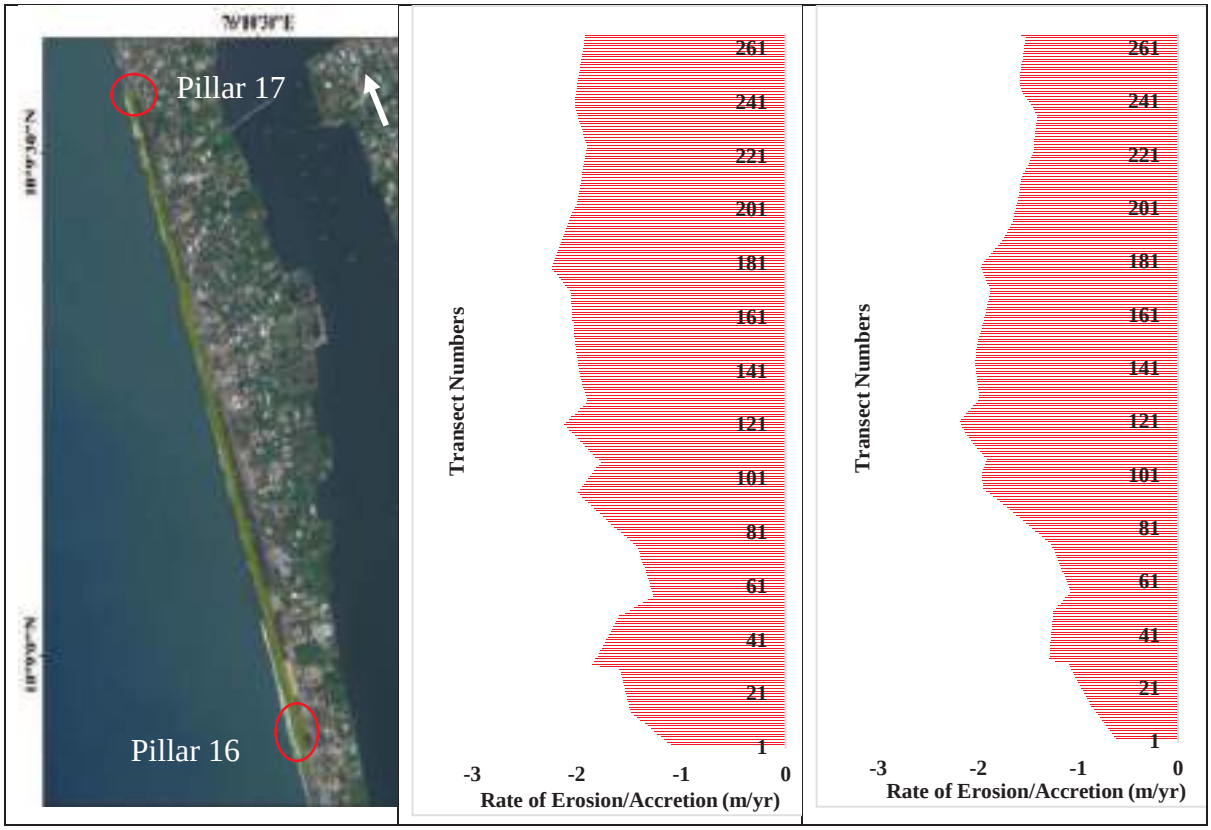


Fig.28b Results of Cell 16 (Pillar 16-17)

5.4.18 Cell 17 (Pillar 17 - Pillar 18)

This stretch is protected by a seawall. **(No immediate action required).**

5.5 Summary and Conclusion

The study area has been identified along the Ernakulam district, Kerala (Vypin to Munambam). The shoreline changes along the coast have been assessed through satellite image processing techniques and statistically analysed using DSAS tool of ArcGIS software application. Significant dynamics in the shoreline changes were observed mostly due to the seasonal monsoon effects along the coast. The analysis states that erosion is more predominant during the southeast monsoon season. The study further highlights the need to have a micro-level approach to understand the shoreline dynamics where site-specific coastal management measures need to be implemented.

- A detailed investigation of the shoreline behaviour using well-established EPR and LRR techniques has been presented.
- The stretches of the coast that are eroding and which needs immediate attention to coastal protection measures have been identified.

- This study is to facilitate us to arrive at the zones of erosion, which should tally with the field observed information.

6.0 FIELD MEASUREMENT

A detailed field investigation study was commissioned to collect real-time field data which includes shoreline mapping, beach profile and sediment characteristics. The study area from Vypin to Munambam was sub-divided into 6 major stretches for ease of executing field measurements the details of which alongside the geo-coordinates of each site are projected in **Table 2**.

S. No.	Place	Starting Point	Ending Point	Distance (km)
		Lat/Long	Lat/Long	
1	Valappu Beach	10º01’54.20” N 76º13’5.76” E	10º0’58.03” N 76º12’50.31” E	1.2
2	Elamkunnapuzha Beach	10º01’12.60” N 76º12’47.50” E	10º1’55.13” N 76º12’33.93” E	1.4
3	Njarackal Arattuvazhi Beach	10º02’15.76” N 76º12’28.03” E	10º2’57.56” N 76º12’16.72” E	1.3
4	Veliyatham Parambu Beach	10º03’3.99” N 76º12’12.54” E	10º3’57.93” N 76º11’54.87” E	1.8
5	Nayarambalam Puthan Kadappuram			
6	Edavankkadu Grama Panchayat	10º04’10.15” N 76º11’50.81” E	10º5’54.10” N 76º11’23.34” E	3.3
7	Pazhangadu			
8	Saidh Mohammed Beach			
9	Kuzhippilly	10º06’7.65” N 76º11’20.07” E	10º09’39.22” N 76º10’17.37” E	6.8
10	Pallipuram			
11	Cherai			
12	Arattu Kadavu Beach			

Table.2 Coordinates of the site

6.1 Methodology

6.1.1 Topographic Survey

Beaches are extremely dynamic in nature experiencing continual changes in shape and shifting position with response to winds, waves, tides, relative sea level, and anthropogenic activities. The most significant changes occur due to seasonal changes in wave climate and during extreme events such as storm surge or cyclone events. The mapping of shoreline as well as demarcation of the existing seawall and groynes structures were measured using RTK GPS

system. The beach profile at various transects for a given coastal stretch was also measured. The details of survey instruments used for field investigation are discussed below.

6.2 Equipment

Navigation and Data Logging System

2 x Trimble R10 RTK GPS with Base and Rover accessories,

1 x Measuring Tape

6.2.1 Trimble R10 GNSS system:

The Trimble R10 GNSS receiver incorporates a GNSS antenna, receiver, internal radio, as shown in **Fig.29** and battery in a rugged light-weight unit that is ideally suited as an all-on-the-pole RTK rover or quick setup/rapid mobilization base station. LEDs enable to monitor satellite tracking, radio reception, data logging status, Wi-Fi status, and power. Bluetooth wireless technology provides cable-free communications between the receiver and controller.

The user can utilize the receiver as part of an RTK GNSS system within the Trimble Access™ software. The receiver can optionally record GNSS data to the receiver's internal memory and download it to a computer or USB flash memory stick. The receiver has no front panel controls for changing settings. To configure the receiver, use the web interface which is available by connecting to the receiver's Wi-Fi via a PC or a smartphone.

Fig.29 Trimble R10 GNSS System

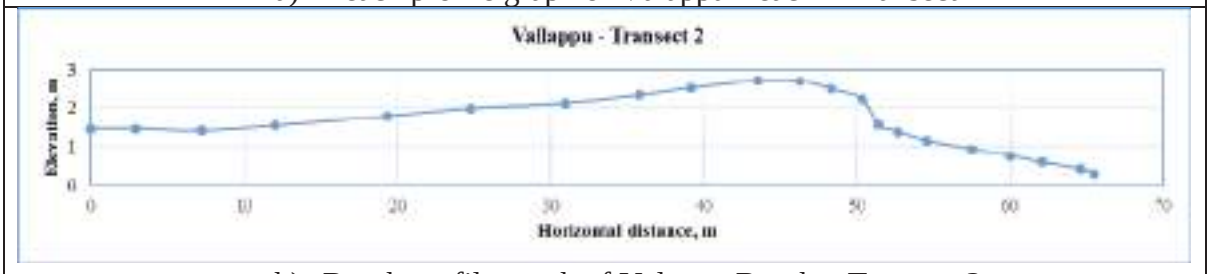
6.3 Results and Discussion

6.3.1 Valappu Beach

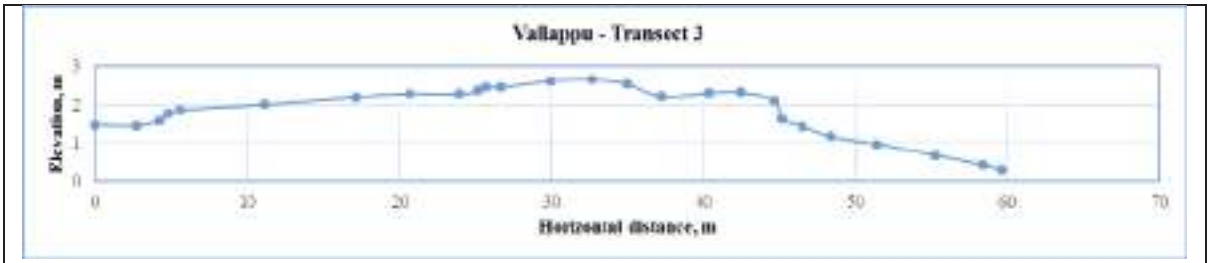
The shoreline (High tide line and Low tide line) are measured from the coordinates 10º01'54.20" N & 76º13'5.76" E to 10º00'58.03" N & 76º12'50.31" E for a distance of 1.2 km and beach profiling was conducted at five transects (see **Fig.30**). The beach profile graphs measured at the site are projected in **Fig.31**. The slope values at these transects are shown in **Table.3.**

Fig.30 Transect locations at Valappu Beach

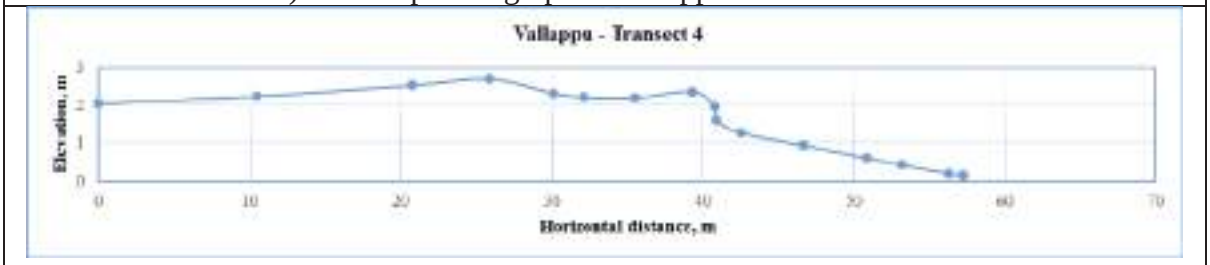
a) Beach profile graph of Valappu Beach – Transect 1



b) Beach profile graph of Valappu Beach – Transect 2



c) Beach profile graph of Valappu Beach – Transect 3



d) Beach profile graph of Valappu Beach – Transect 4

e) Beach profile graph of Valappu Beach – Transect 5

Fig.31 Beach profile graph of Valappu Beach– Transect 1-5

Table.3 Beach Slope values at Valappu Beach

Transect ID	Slope
Vallappu Transect 1	1 in 11.4
Vallappu Transect 2	1 in 11.8
Vallappu Transect 3	1 in 11.5
Vallappu Transect 4	1 in 11.8
Vallappu Transect 5	1 in 12.4

6.3.2 Elamkunnapuzha Beach

The shoreline (High tide line and Low tide line), and existing seawall are measured from the coordinates 10º01'12.60" N & 76º12'47.50" E to 10º01'55.13" N & 76º12'33.93" E for a distance of 1.4km and beach profiling was conducted at two transects (see **Fig.32**). The south transect 2 lies the open beach and the north of transect 2 is covered with seawall. The beach profile graphs measured at the site are projected in **Fig.33**. The slope values at these transects are shown in **Table 4.**

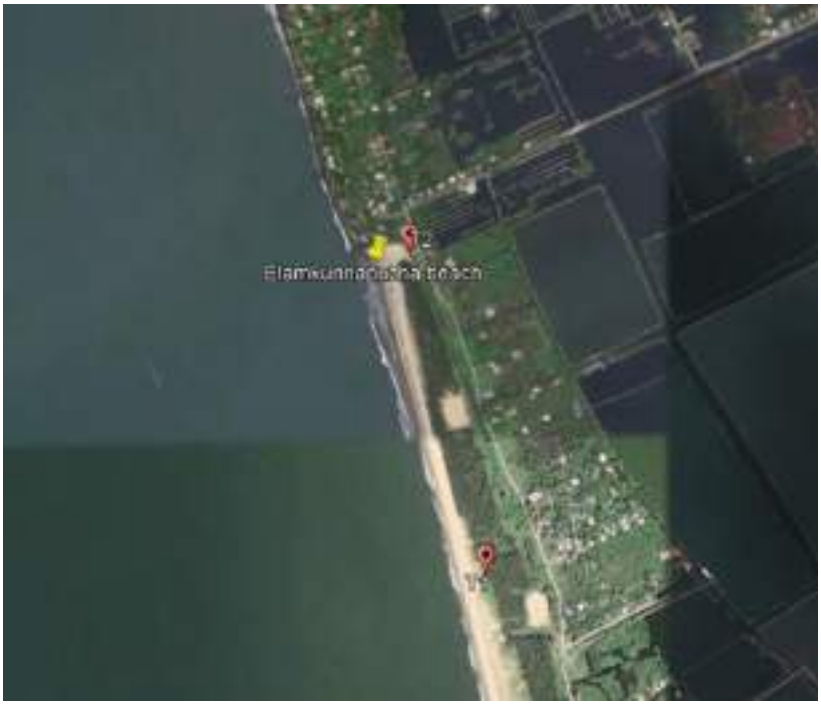
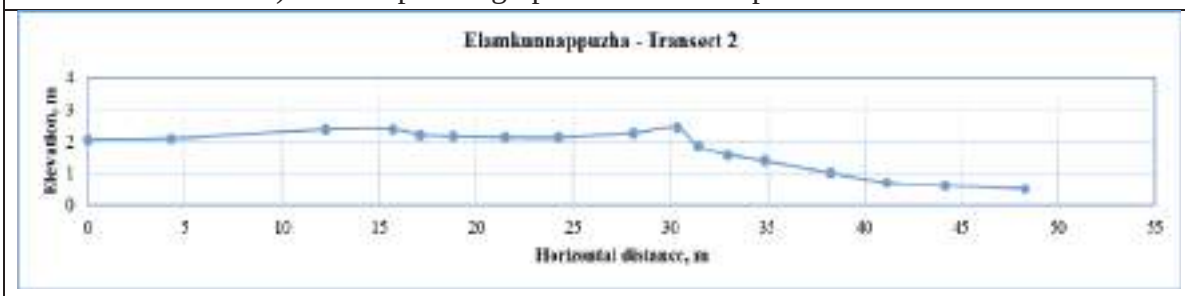


Fig.32 Aerial view of Elamkunnapuzha Beach with transects

a) Beach profile graph of Elamkunnapuzha – Transect 1



b) Beach profile graph of Elamkunnapuzha – Transect 2

Fig.33 Beach profile graph of Elamkunnapuzha – Transect 1- 2

Table.4 Beach Slope values at Elamkunnapuzha Beach

Transect ID	Slope
Elamkunnappuzha - Transect 1	1 in 14.2
Elamkunnappuzha - Transect 2	1 in 12.4

6.3.3 Njarackal Arattuvazhi Beach

The shoreline (High tide line and Low tide line), and existing seawall are measured from the coordinates 10º2'15.76" N & 76º12'28.03" E to 10º2'57.56" N & 76º12'16.72" E for a distance of 1.3km and beach profiling was conducted at one transect (see **Fig.34**). Here most of the coastal stretch is protected with a seawall and only a few meters of open beach front is available. The beach profile graph of the site is shown in **Fig.35.** The slope value of this transect is 1 in 8.1.

Fig.34 Transect locations at Njarackal Arattuvazhi Beach

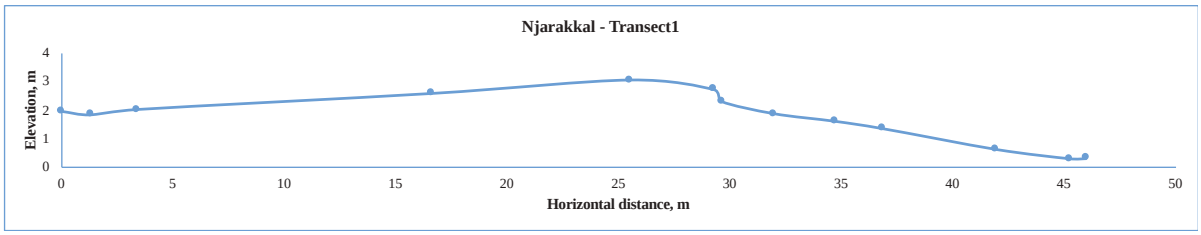


Fig.35 Beach profile graph of Njarackal Arattuvazhi – Transect 1

6.3.4 Veliyatham Parambu Beach & Nayarambalam Puthan Kadappuram

The existing seawall is measured from the coordinates 10º3'3.99" N & 76º12'12.54" E to 10º3'57.93" N & 76º11'54.87" E for a distance of 1.8 km. The aerial view of Veliyatham Parambu Beach and Nayarambalam Puthan Kadappuram are shown in **Fig 36** and **Fig 37** respectively.

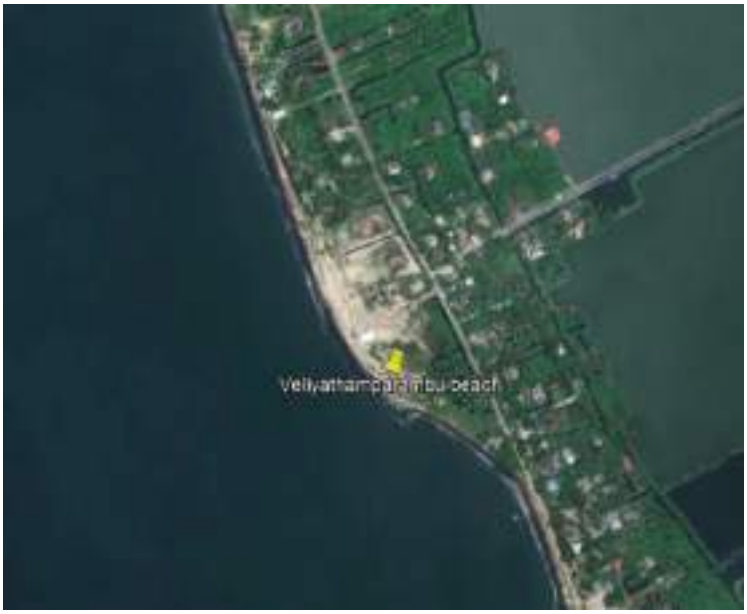


Fig.36 Aerial view of Veliyatham Parambu Beach

Fig.37 Aerial view of Nayarambalam Puthan Kadappuram Beach

6.3.5 Edavanakkadu Grama Panchayat, Pazhangadu & Saidh Mohammed Beach

The shoreline (High tide line and Low tide line), and existing seawall are measured from the coordinates 10º4'10.15" N & 76º11'50.81" E to 10º5'54.10" N & 76º11'23.34" E for a distance of 3.3km and beach profiling was conducted at one transect for each for the aforesaid coastal stretch. The location of the transect for Edavanakkadu Grama Panchayat, Pazhangadu and Saidh Mohammed Beach coastal stretches are shown in **Figs 38**, **39, 40** respectively. The beach profile graphs of Edavanakkadu Grama Panchayat, Pazhangadu and Saidh Mohammed Beach

coastal stretches are shown in **Fig 41, 42, 43** respectively. The beach slopes at Edavanakkadu Grama Panchayat, Pazhangadu and Saidh Mohammed Beach coastal stretches are 1 in 19.8, 1 in 5.3 and 1 in 10.3 respectively.

Fig.38 Transect location at Edavanakkadu Grama Panchayat Beach

Fig.39 Transect location at Pazhangadu Beach

Fig.40 Transect location at Saidh Mohammed Beach

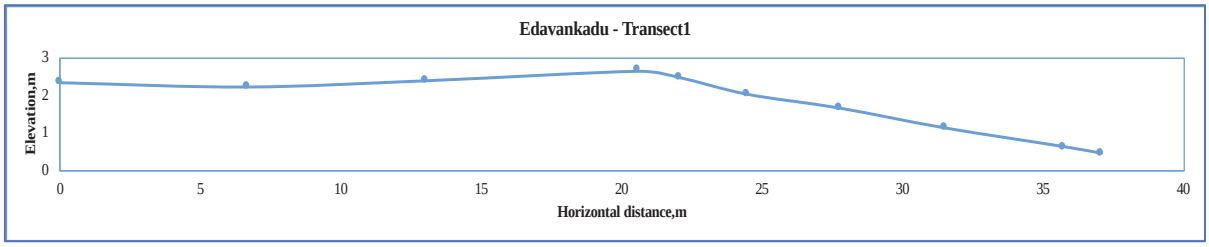


Fig.41 Beach profile graph of Edavanakkadu Grama Panchayat – Transect 1

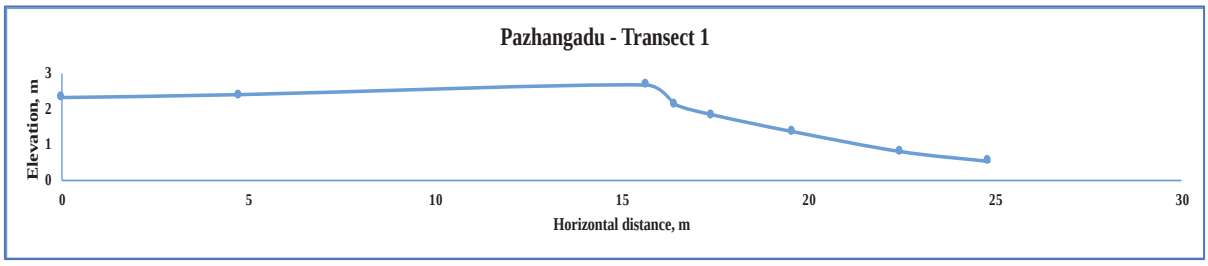


Fig.42 Beach profile graph of Pazhangadu – Transect 1

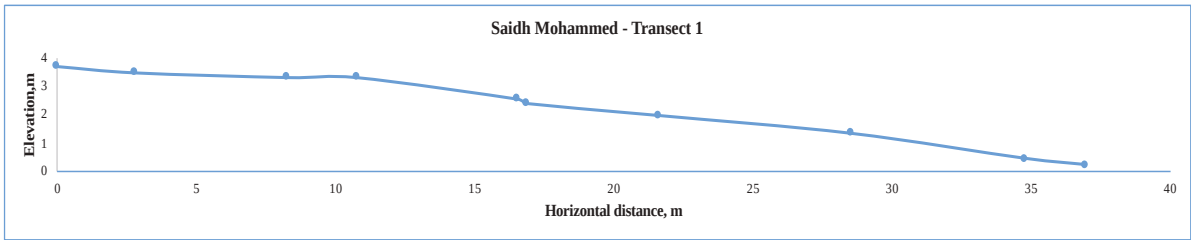


Fig.43 Beach profile graph of Saidh Mohammed – Transects 1

6.3.6 Kuzhippilly, Pallipuram, Cherai & Arattu Kadavu Beach

The shoreline (High tide line and Low tide line), and existing seawall are measured from the coordinates 10º6'7.65" N & 76º11'20.07" E to 10º9'39.22" N & 76º10'17.37" E for a distance of 6.8km and beach profiling was conducted at twenty-two transects. The aerial view of Kuzhippilly beach with transects is shown in **Fig.44.** The beach profile graphs measured at Kuzhippilly are projected in **Fig.45** and the slope values at these transects are shown in **Table 5.**

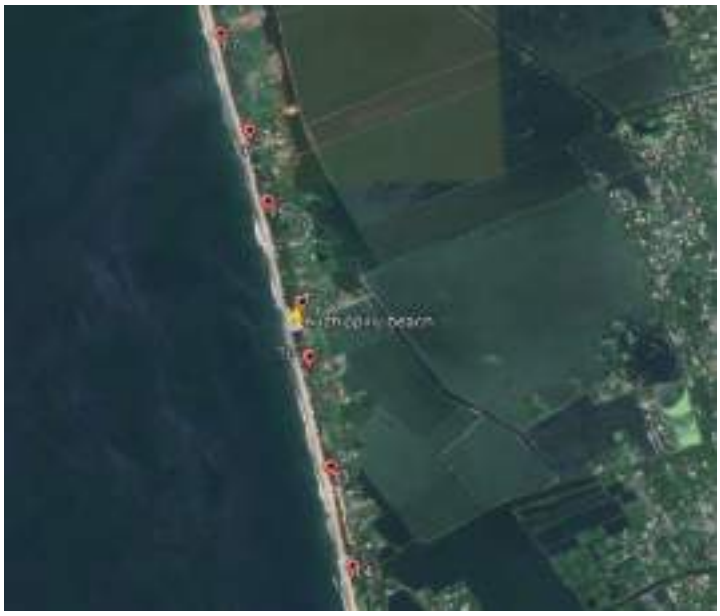
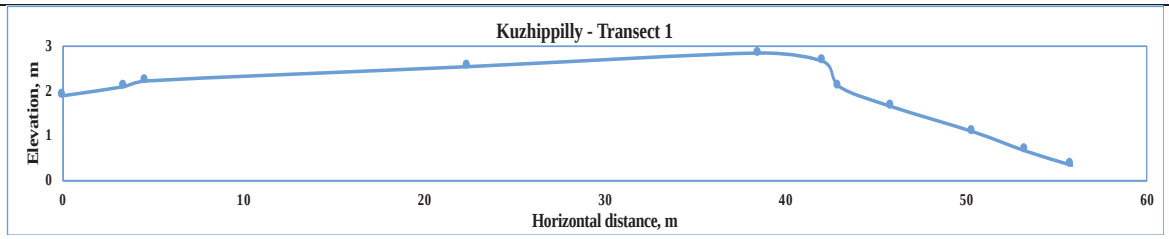
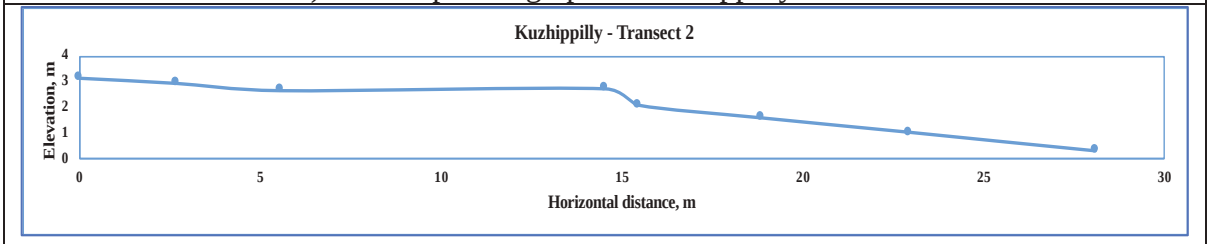


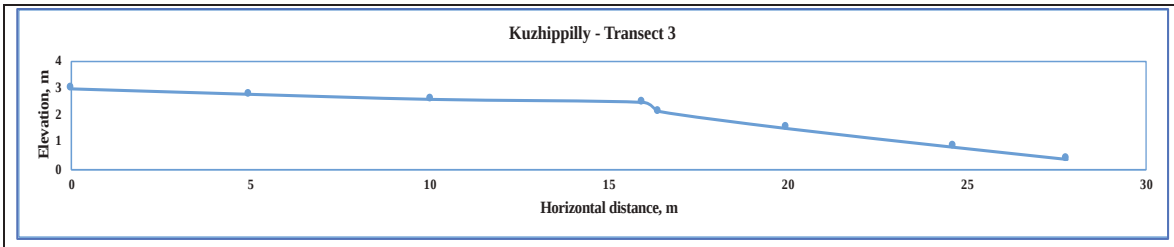
Fig.44 Aerial view of Kuzhippilly Beach with transects



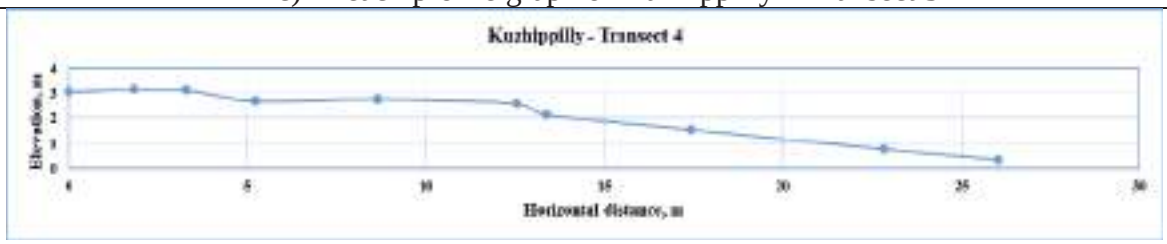
a) Beach profile graph of Kuzhippilly – Transect 1



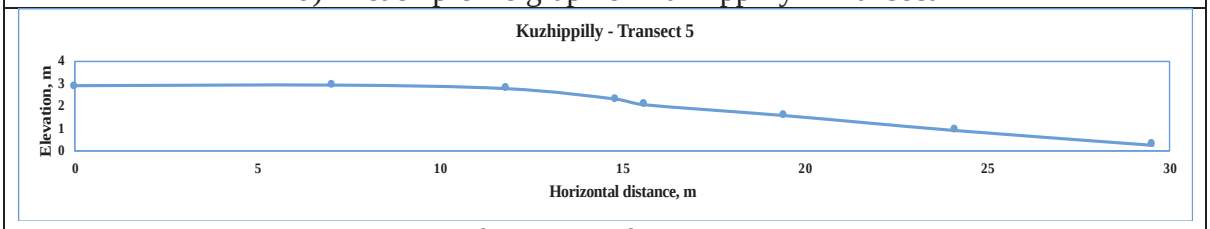
b) Beach profile graph of Kuzhippilly – Transect 2



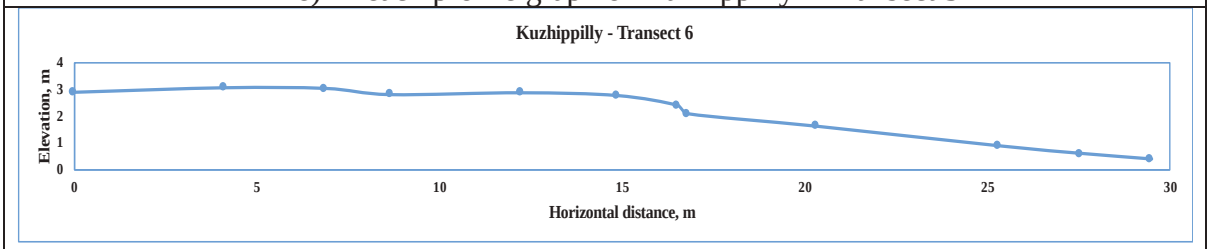
c) Beach profile graph of Kuzhippilly – Transect 3



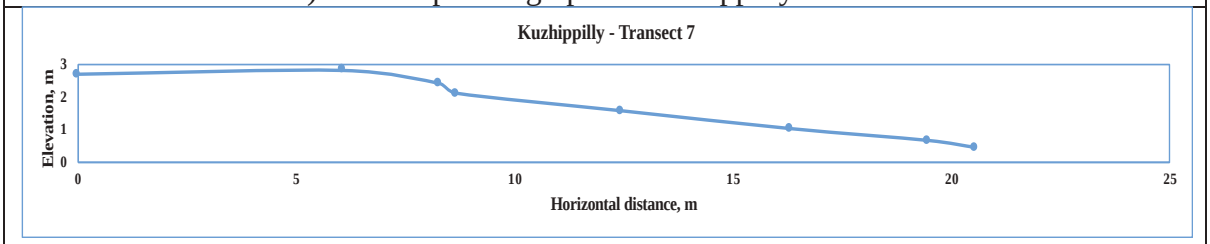
d) Beach profile graph of Kuzhippilly – Transect 4



e) Beach profile graph of Kuzhippilly – Transect 5



f) Beach profile graph of Kuzhippilly – Transect 6



g) Beach profile graph of Kuzhippilly – Transect 7

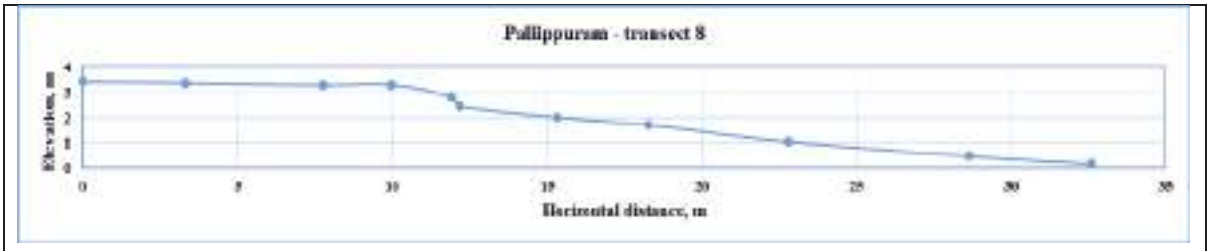
Fig.45 Beach profile graph of Kuzhippilly – Transect 1- 7

Table.5 Slope of Kuzhippilly Beach Transects

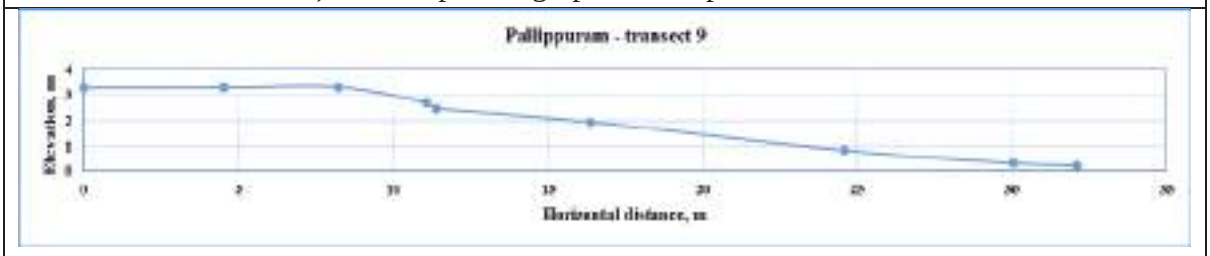
Transect ID	Slope
Kuzhippilly - Transect 1	1 in 7.4
Kuzhippilly - Transect 2	1 in 7.1
Kuzhippilly - Transect 3	1 in 6.3
Kuzhippilly - Transect 4	1 in 7
Kuzhippilly - Transect 5	1 in 7.7
Kuzhippilly - Transect 6	1 in 7.3
Kuzhippilly - Transect 7	1 in 7.2

The aerial view of Pallipuram beach with transects is shown in **Fig.46.** The beach profile graphs measured at Pallipuram are projected in **Fig.47** and the slope values at these transects are shown in **Table 6.**

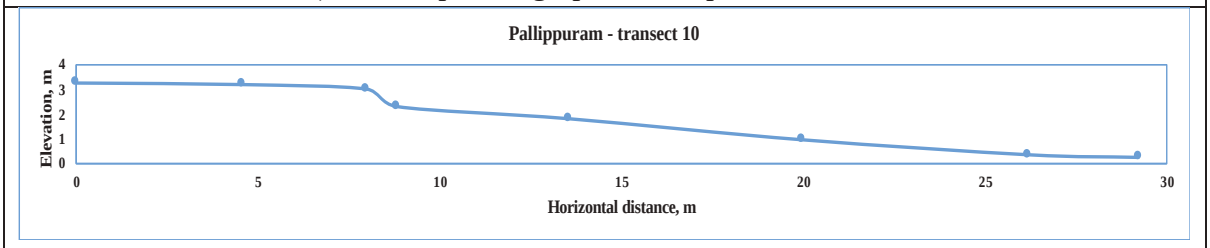
Fig.46 Aerial view of Pallipuram Beach with transects



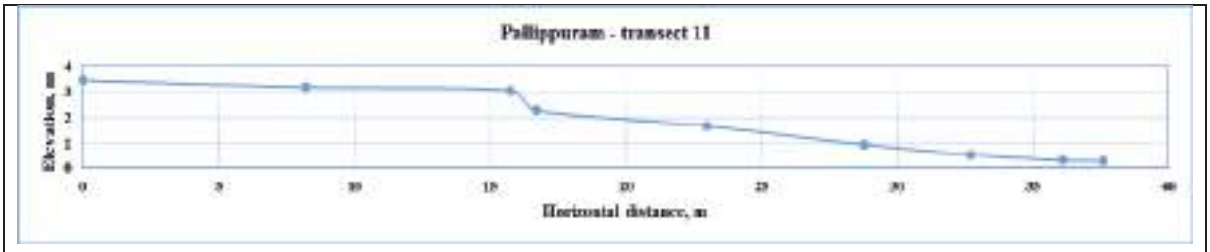
a) Beach profile graph of Pallipuram – Transect 8



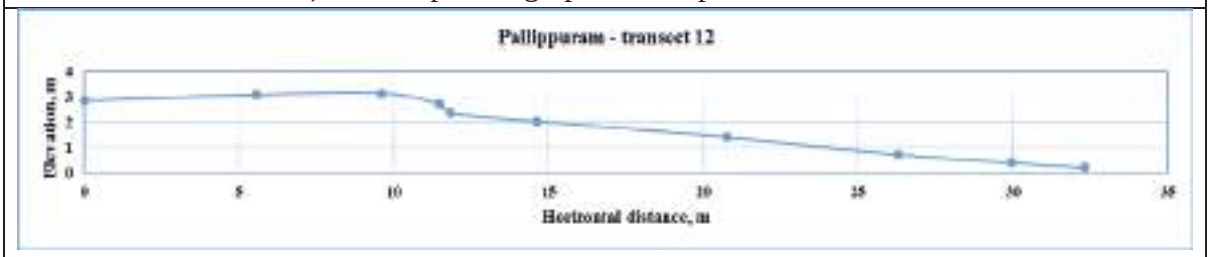
b) Beach profile graph of Pallipuram – Transect 9



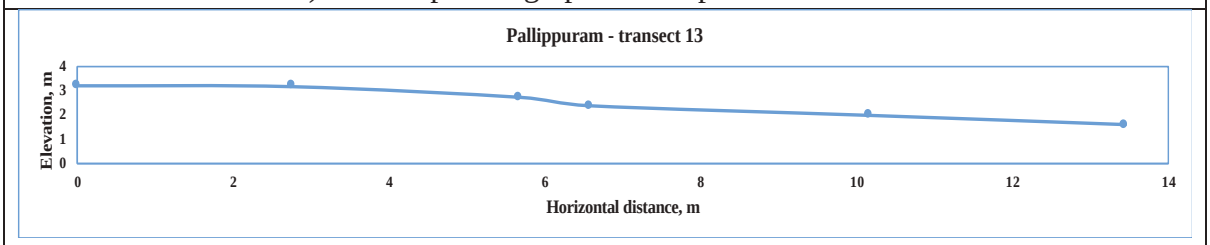
c) Beach profile graph of Pallipuram – Transect 10



d) Beach profile graph of Pallipuram – Transect 11



e) Beach profile graph of Pallipuram – Transect 12



f) Beach profile graph of Pallipuram – Transect 13

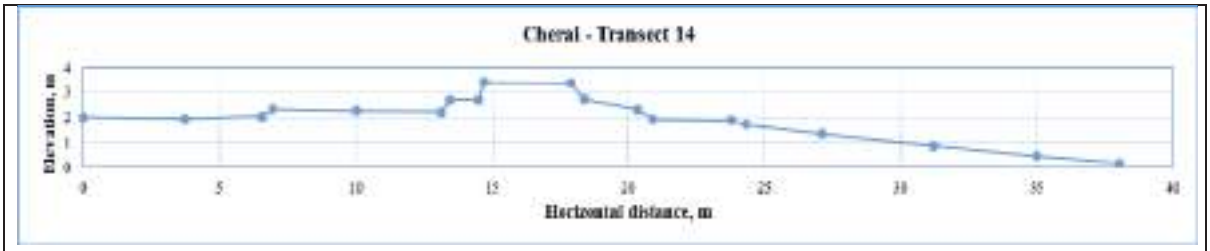
Fig.47 Beach profile graph of Pallipuram – Transect 8-13

Table.6 Slope of Pallipuram Beach Transects

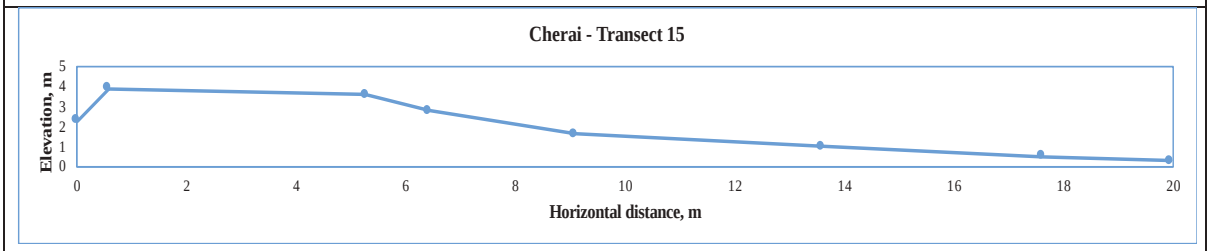
Transect ID	Slope
Pallipuram - Transect 8	1 in 8.7
Pallipuram - Transect 9	1 in 8.8
Pallipuram - Transect 10	1 in 9.5
Pallipuram - Transect 11	1 in 9.9
Pallipuram - Transect 12	1 in 9.3
Pallipuram - Transect 13	1 in 8.7

The aerial view of Cherai beach with transects is shown in **Fig.48.** The beach profile graphs measured at Cherai have been projected in **Fig.49** and the slope values at these transects are shown in **Table.7.**

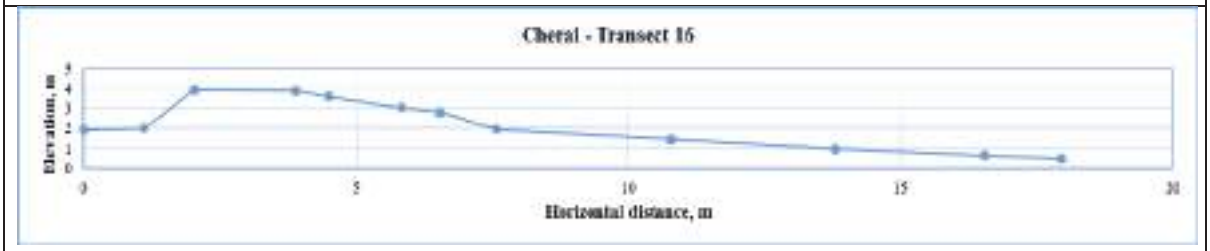
Fig.48 Aerial view of Cherai Beach with transects



Beach profile graph of Cherai – Transect 14



Beach profile graph of Cherai – Transect 14



Beach profile graph of Cherai – Transect 14

Fig.49 Beach profile graph of Cherai – Transect 14-16

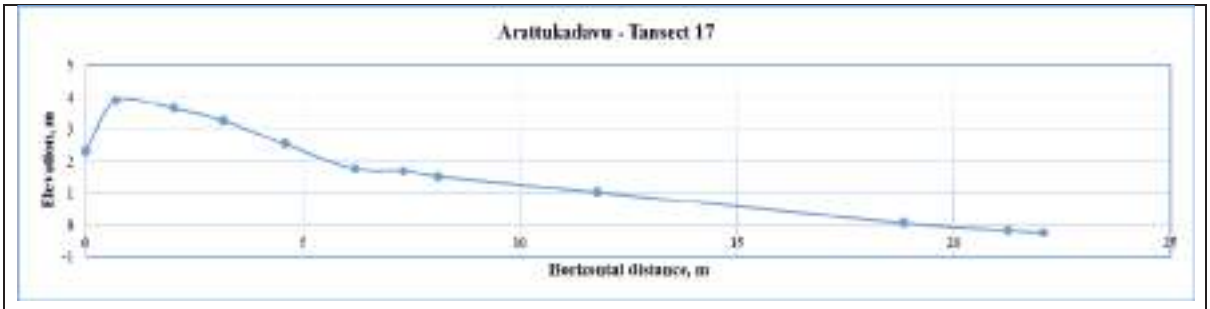
Table.7 Slope of Cherai Beach Transects

Transect ID	Slope

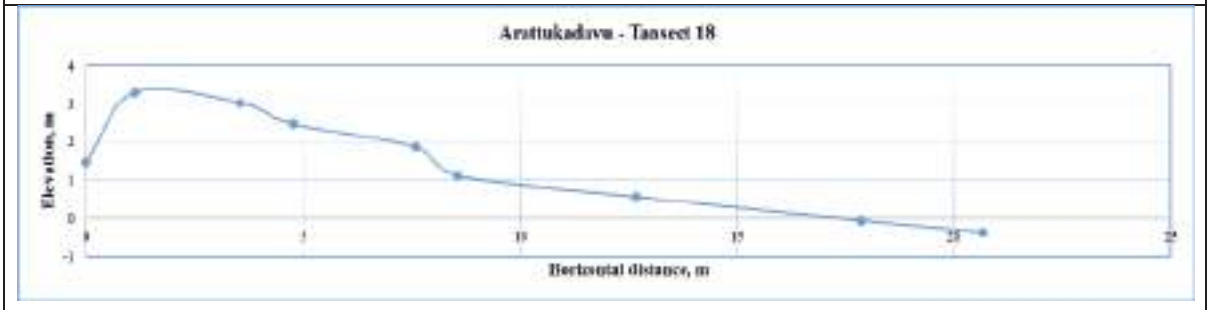
Cherai - Transect 8	1 in 8.7
Cherai - Transect 9	1 in 8.8
Cherai - Transect 10	1 in 9.5

The aerial view of Arattu Kadavu beach with transects is shown in **Fig.50.** The beach profile graphs measured at Arattu Kadavu are projected in **Fig.51** and the slope values at these transects are shown in **Table 8.**

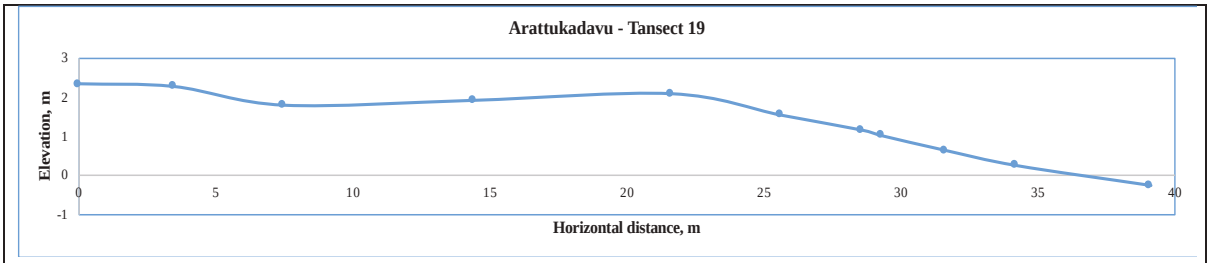
Fig.50 Aerial view of Arattu Kadavu Beach with transects



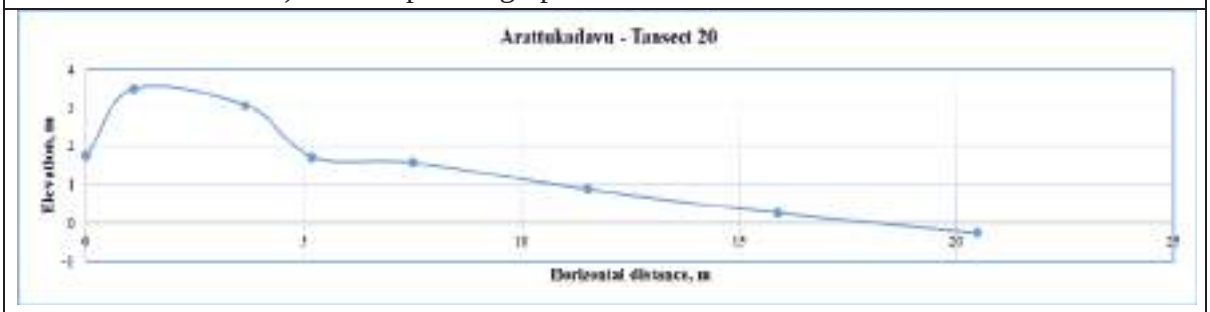
a) Beach profile graph of Arattu Kadavu – Transect 17



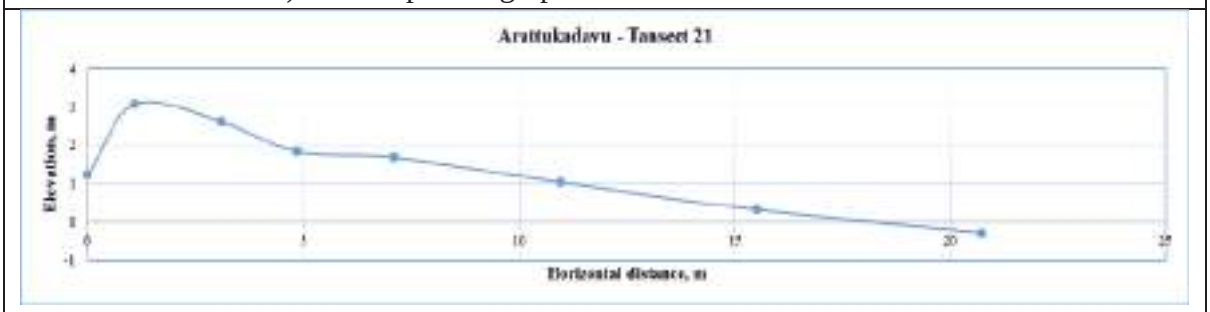
b) Beach profile graph of Arattu Kadavu – Transect 18



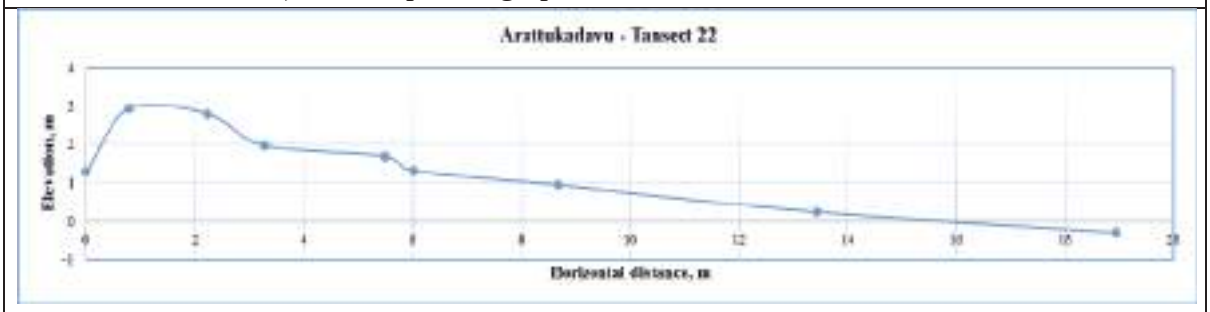
c) Beach profile graph of Arattu Kadavu – Transect 19



d) Beach profile graph of Arattu Kadavu – Transect 20



e) Beach profile graph of Arattu Kadavu – Transect 21



f) Beach profile graph of Arattu Kadavu – Transect 22

Fig.51 Beach profile graph of Arattu Kadavu – Transect 17-22

Table.8 Slope of Arattu Kadavu Beach Transects

Transect ID	Slope
Arattu Kadavu - Transect 17	1 in 7.6
Arattu Kadavu - Transect 18	1 in 8.2
Arattu Kadavu - Transect 19	1 in 7.2
Arattu Kadavu - Transect 20	1 in 7.1
Arattu Kadavu - Transect 21	1 in 6.9
Arattu Kadavu - Transect 22	1 in 7.9

6.4 Sediment Analysis

The grain size distribution curve graph of collected samples is shown in **Fig.52** and specific gravity, uniformity co-efficient and co-efficient of curvature results were given in **Table.9.**

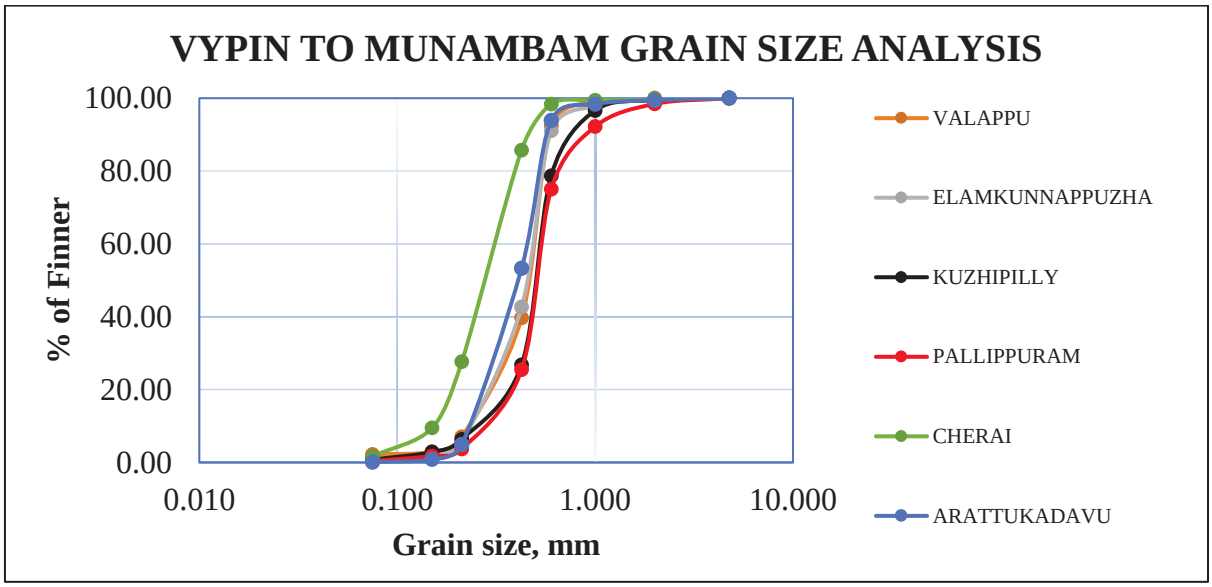


Fig. 52 Sediment Size Analysis

Table.9 Vypin to Munambam onshore soil sample test results

Sample ID	Distribution size				Coefficient of uniformity,Cu	Coefficient of curveture,Cc
	D10	D30	D50	D60		
Valappu	0.231	0.362	0.459	0.492	2.129	1.149
Elamkunnapuzha	0.236	0.352	0.451	0.488	2.064	1.074
Kuzhippilly	0.250	0.436	0.503	0.537	2.149	1.415
Pallippuram	0.274	0.441	0.512	0.547	2.000	1.301
Cherai	0.152	0.221	0.294	0.331	2.178	0.970
Arattukadavu	0.234	0.322	0.410	0.454	1.937	0.977

7.0 WAVE MODELLING

7.1 General

An application of the spectral wave prediction model for the Arabian Sea has been carried out to evaluate the spectral wave parameters offshore off the Vypin to Munanbam for the planning

of coastal protection. The global wave model is based on the "WAM" model has been adopted. This model simulates the evolution of two-dimensional ocean waves using the spectral energy balance equation, in which wave energies are balanced with the local wind input, wave dissipation and non-linear energy transfer. The coarser grid model has been executed over a regional domain, which includes the Indian Ocean, Bay of Bengal and the Arabian Sea. The finer grid model has been set up over the Arabian Sea with a focus along the south-west coast of India with boundary information from the coarse grid model. ECMWF wind vectors over an annual year have been obtained for the domain of interest and the wind-waves have been evaluated at a deep-water location off the study area as mentioned above. The near shore wave modeling that includes diffraction due to breakwaters caters for propagating deep water waves into the near shore. The littoral drift study transforms the deep-water wave climate into near shore normal wave characteristics.

7.2 The wave model WAM

The WAM-model is a third-generation wave model, which solves the wave transport equation explicitly without any presumptions on the shape of the wave spectrum. The model runs for any a given regional or global grid with a prescribed topographic dataset. The grid resolution is arbitrary in space and time. The propagation can be done on a spherical (longitudinal-latitudinal) or Cartesian grid. The integration can be interrupted and restarted at arbitrary times. The equation for the energy balance of the wave spectrum, representing the basis of a possible exact theory of wave spectrum dynamics is,

$$\frac{\partial F}{\partial t}(k,x,t)+\upsilon.\nabla_x F(k,x,t)=S \qquad (4)$$

where F(k,x,t) is the energy spectrum in terms of wave number vector, k, the position vector, x in the ocean and time t. The group velocity vector, ν, is defined as,

$$\upsilon=\frac{1}{2}\sqrt{\frac{g}{k}\left(\frac{k}{k}\right)} \qquad (5)$$

The second term on the left-hand side is the divergence of the convective energy flux, ν.F, and S is the total rate of change of the spectrum due to the generation, dissipation, and non-linear processes in the sea. For a given wind condition, the effects of fetch, duration, varying wind fields would be solved automatically by the computer integration of the differential equation.

The WAM model [Komen et al. (1994)] was developed as the global third generation model to solve the action balance equation in spherical coordinates for the action density ocean wave spectrum $F(f,\theta,\phi,\lambda,t)$ with respect to wave frequency f and direction θ as a function of latitude ϕ, longitude λ and time t, which is governed by the transport equation,

$$\frac{\partial F}{\partial t}+(\cos\phi)^{-1}\frac{\partial}{\partial\phi}\left(\dot{\phi}\cos\phi F\right)+\frac{\partial}{\partial\lambda}\left(\dot{\lambda}F\right)+\frac{\partial}{\partial\omega}(\dot{\omega}F)+\frac{\partial}{\partial\theta}\left(\dot{\theta}F\right)=S \qquad (6)$$

where, the dotted variables, $\dot{\phi},,\dot{\lambda},\dot{\omega},\dot{\theta}$ represent the rate of change of the positions, the dispersion relation and propagating direction of waves travelling globally.

The source function is represented as superposition of source terms due to wind input, non-linear wave-wave interaction, dissipation due to wave breaking, and bottom friction. This leads to

$$S = S_{in} + S_{nl} + S_{ds} + S_{bot} \qquad (7)$$

Except for the non-linear source term, which uses the discrete interaction approximation that simulates an exact non-linear transfer process formulated by the four-wave resonant interaction Boltzmann equation and characterizes the third-generation model, all the other source terms are individually parameterized to be proportional to the action density spectrum, F. The numerical integration of the source function is performed with an implicit integration scheme while the propagation scheme is a first order upwind flux scheme to handle the large difference between the dynamic adjustment time of the highest frequency and the integration time step. A consequence of the explicit scheme is that the time-step is proportional to the spatial step size. Therefore, as the mesh is refined, the time step must be reduced to maintain stability, thus increasing the computational effort. The wind time step can be chosen arbitrarily. Details of the processes and their implementations are given by Gunther et al. (1992) and Komen et al. (1994).

7.3 Functionality and Output of the Model

The following wave propagation processes are implemented in the model:

- Spherical propagation
- deep and shallow water
- depth refraction
- dissipation due to white-capping and depth limitation

- wave generation by wind
- non-linear wave-wave interaction

The model provides the following output quantities:

- significant wave height
- mean wave direction
- mean frequency

7.3.1 Model setup

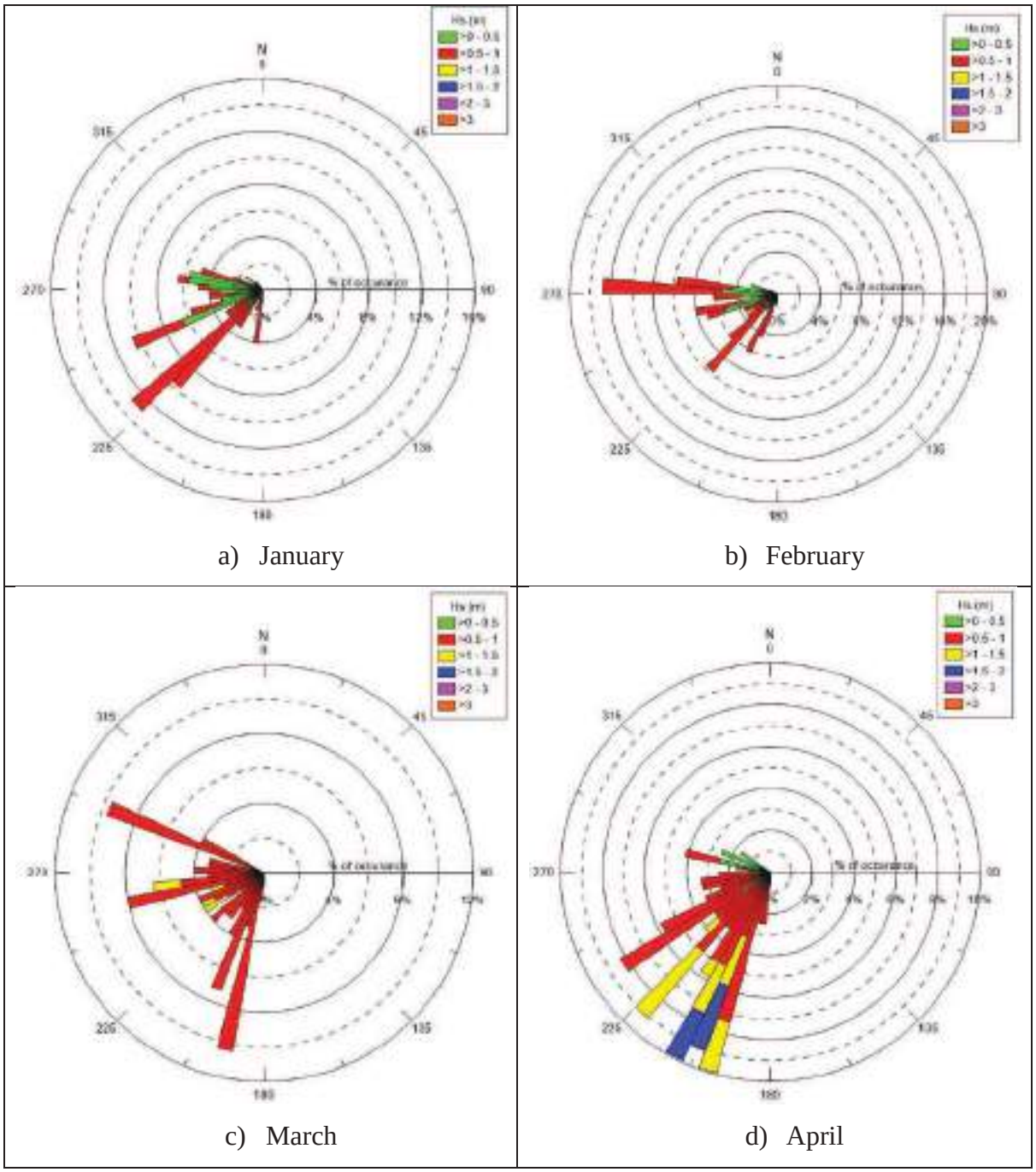
The coarse grid bathymetry over the Indian waters is taken from GEBCO with 9.0 km resolution in latitude and longitude (Cartesian grid), covering the region 30^o E to 120^{o}E and 50^{o}S to 30^{o}N. The WAM is initially been set-up in the Indian Ocean comprises also the Bay of Bengal and the Arabian Sea which is bounded by the region 30^{o}E-120^{o}E & -50^{o}S-30^{o}N. A spherical grid resolution of 1/4^o x 1/4^o with 15^o angular resolution for the directional spectra and 10-minute propagation time step is chosen. A finer grid model over the Arabian Sea covering the southern west-coast of India which is facing the Arabian sea has been set up in the domain covering longitudes 75.5^{o}E to 76.5^{o}E & latitudes 9.5^{o}N to 10.5^{o}N. The grid resolution is 1.5' x 1.5'. The same bathymetry file, GEBCO was used. The open boundary information for this finer grid model has been obtained from the coarser grid model. The employed wind data is the one entire annual year wind vectors obtained from ECMWF. The winds data is of 0.25^o x 0.25^o resolution.

The wave hind-casting has been carried out using 24 directional bands, 25 frequency bands and frequency intervals extending from 0.042 to 0.41 Hz. For the coarser grid model, 10 minutes time step has been used for the integration of advection and source terms, considering the depth-dependent refraction. The above time step is 1minutes for the finer grid run. The output time step adopted is 6 hours and the initial condition for the wave model has been set up by executing the wave model from its calm state for 5 days.

7.3.2 Wave characteristics

The wave characteristics such as significant wave height, mean wave period and mean wave direction at a deep-water location (10° 0'0.00"N, 76° 0'0.00"E) have been extracted at every 6 hours interval. The wave field follows the wind pattern. It is noted that the spatial variability is closely related, the maximum H_s are associated with maximum wind speeds. **Fig.53 & 54.** represents the monthly and annual occurrence of wave climate. It is noticed that the offshore wave climate is predominantly from the west and south-west.

The joint distribution tables of significant wave height vs. wave direction, mean wave period vs. mean wave direction and significant wave height vs. mean wave period are presented in **Tables. 10, 11 and 12** respectively. The waves are predominantly of period varying from 6s to 8s period with the significant wave height ranging between 0.5m and 1m. However, higher waves with less probability of occurrence were also observed.

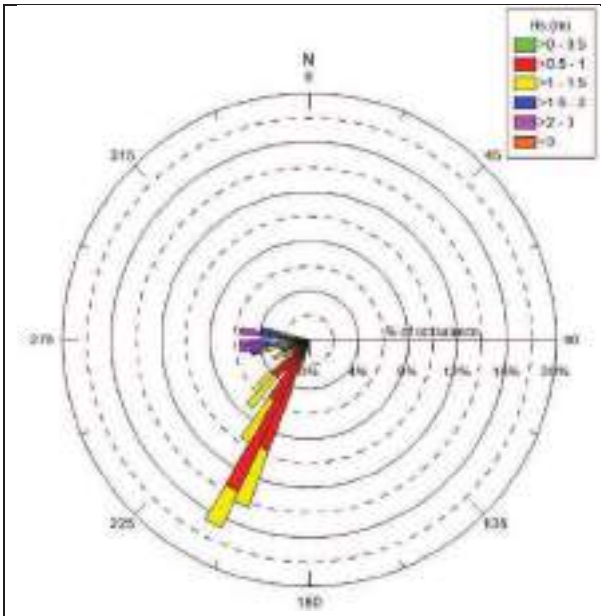


a) January

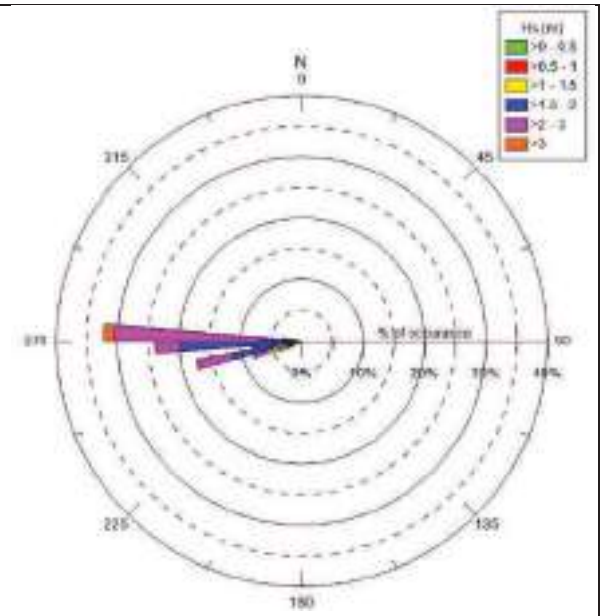
b) February

c) March

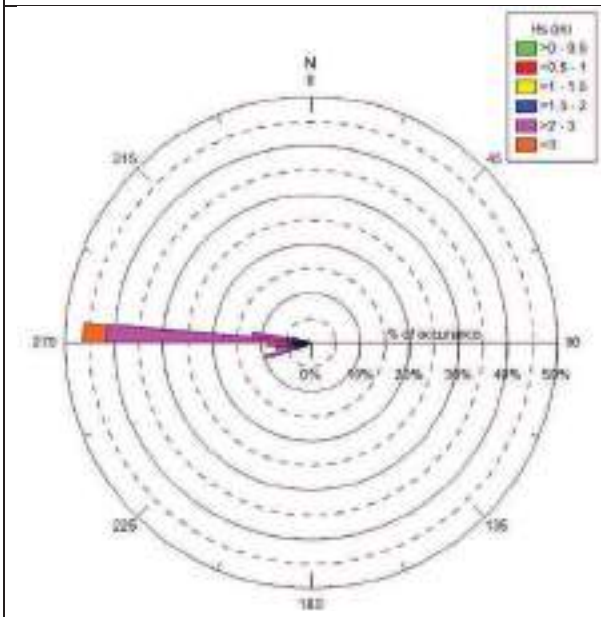
d) April



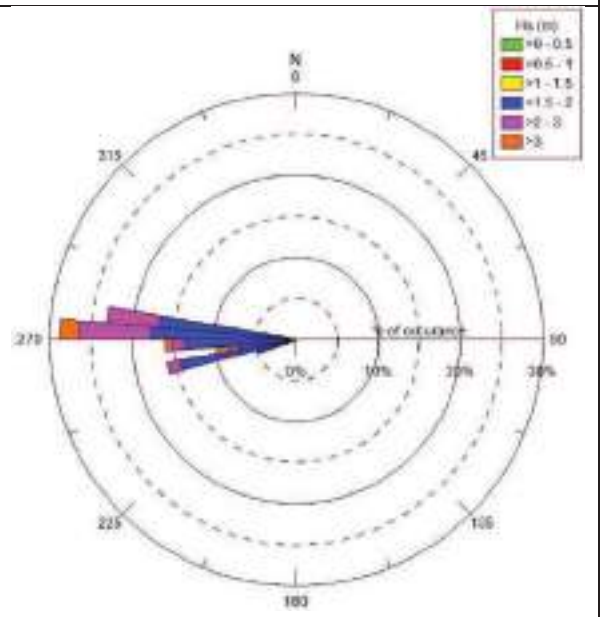
e) May



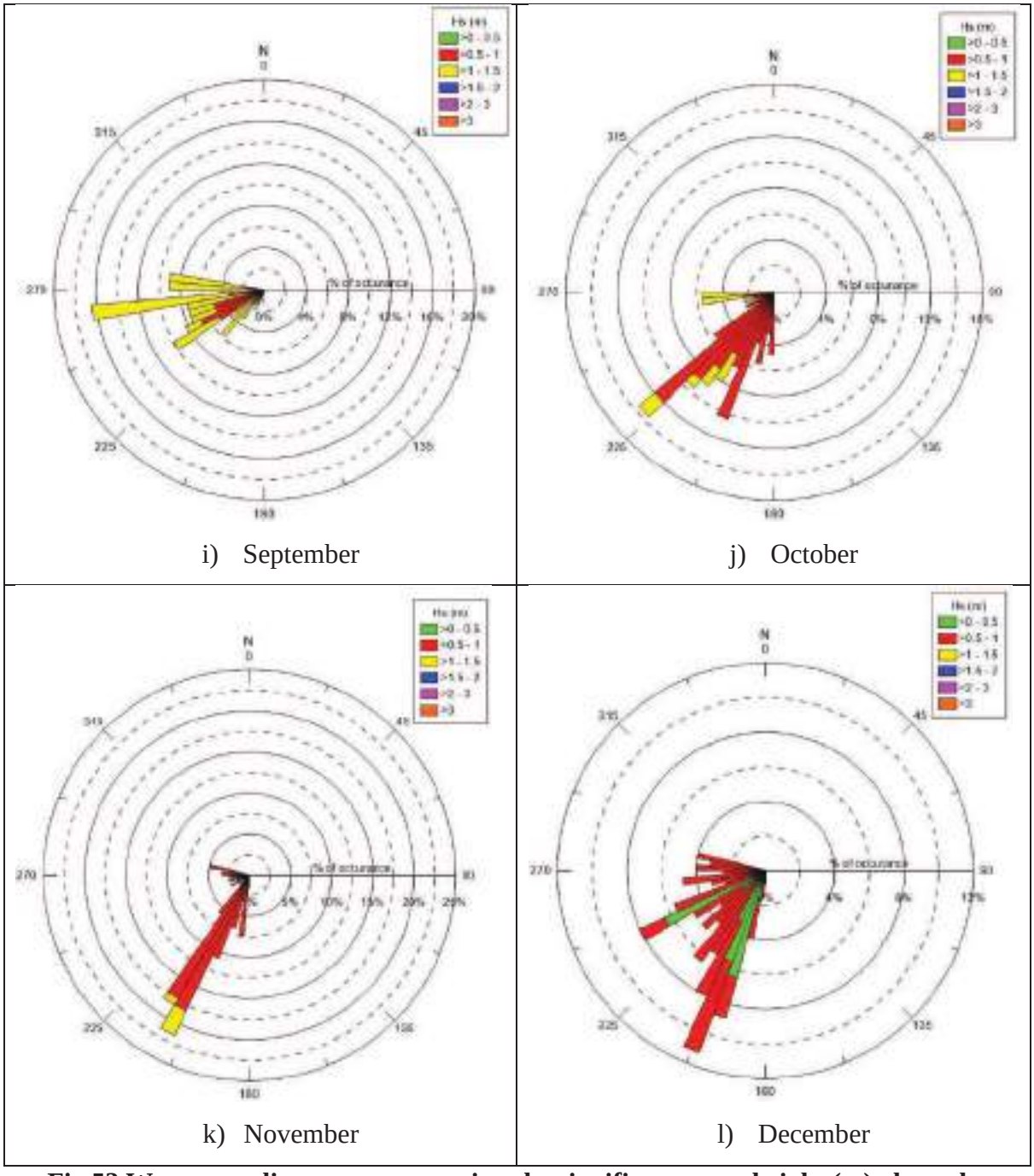
f) June



g) July



h) August



i) September

j) October

k) November

l) December

Fig.53 Wave rose diagram representing the significant wave height (m) along the direction for the month of January to December.

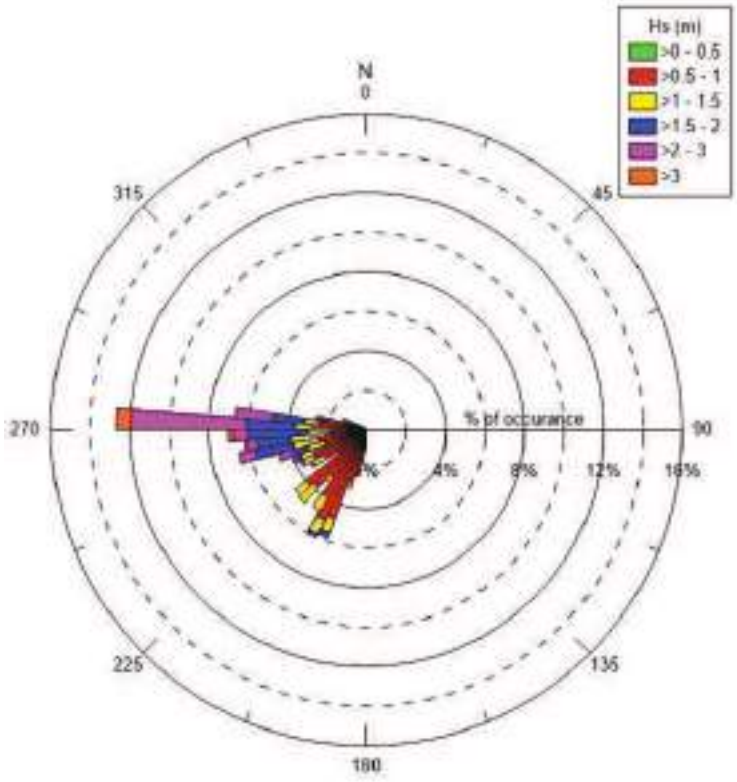


Fig.54 Wave rose diagram representing the significant wave height (m) along the direction for an annual year

Table.10 Wave height vs Mean direction joint distribution

Wave direction	Wave Height (m)										Total
	0-0.5	0.5-1	1-1.5	1.5-2	2-2.5	2.5-3	3-3.5	3.5-4	4-4.5	4.5-5	
N-NNE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
NNE-NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
NE-NEE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
NEE-E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
E-SEE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
SEE-SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
SE-SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**

SSE-S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
S-SSW	0.14	2.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**2.88**
SSW-SW	1.85	15.49	2.40	0.48	0.00	0.00	0.00	0.00	0.00	0.00	**20.22**
SW-SWW	1.10	13.23	2.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**17.07**
SWW-W	2.88	8.84	3.70	2.19	1.85	0.07	0.00	0.00	0.00	0.00	**19.53**
W-NWW	3.02	7.40	4.66	9.87	4.04	5.28	1.17	0.00	0.00	0.00	**35.44**
NWW-NW	1.44	2.67	0.07	0.21	0.14	0.00	0.07	0.00	0.00	0.00	**4.59**
NW-NNW	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.27**
NNW-N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Total	**10.69**	**50.38**	**13.57**	**12.75**	**6.03**	**5.35**	**1.23**	**0.00**	**0.00**	**0.00**	**100.00**

Table.11 Wave Period vs Mean direction joint distribution

Wave direction	**Wave Period (s)**										**Total**
	0-2	**2-4**	**4-6**	**6-8**	**8-10**	**10-12**	**12-14**	**16-18**	**18-20**	**20-22**	**22-24**	
N-NNE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
NNE-NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
NE-NEE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
NEE-E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
E-SEE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**

SEE-SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
SE-SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
SSE-S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
S-SSW	0.00	0.00	0.41	0.75	1.37	0.34	0.00	0.00	0.00	0.00	0.00	**2.88**
SSW-SW	0.00	0.00	0.27	10.08	8.22	1.30	0.34	0.00	0.00	0.00	0.00	**20.22**
SW-SWW	0.00	0.00	0.75	11.10	4.25	0.96	0.00	0.00	0.00	0.00	0.00	**17.07**
SWW-W	0.00	0.00	1.85	13.23	4.18	0.27	0.00	0.00	0.00	0.00	0.00	**19.53**
W-NWW	0.00	0.00	5.28	14.26	15.35	0.55	0.00	0.00	0.00	0.00	0.00	**35.44**
NWW-NW	0.00	0.14	3.77	0.27	0.41	0.00	0.00	0.00	0.00	0.00	0.00	**4.59**
NW-NNW	0.00	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.27**
NNW-N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Total	**0.00**	**0.14**	**12.61**	**49.69**	**33.79**	**3.43**	**0.34**	**0.00**	**0.00**	**0.00**	**0.00**	**100.00**

Table.12 Wave height vs mean period joint distribution

Hs (m)	**Tm (s)**												**Total**
	2	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	
0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
1	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.14**
1.5	3.98	8.43	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**12.61**

2	6.37	29.13	9.32	3.84	0.75	0.27	0.00	0.00	0.00	0.00	0.00	0.00	**49.69**
2.5	0.21	11.03	3.36	8.43	4.93	4.93	0.89	0.00	0.00	0.00	0.00	0.00	**33.79**
3	0.00	1.78	0.62	0.21	0.34	0.14	0.34	0.00	0.00	0.00	0.00	0.00	**3.43**
3.5	0.00	0.00	0.07	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.34**
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
4.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Total	**10.69**	**50.38**	**13.57**	**12.75**	**6.03**	**5.35**	**1.23**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**100.00**

7.4 Validation of the Model (WAM)

The significant wave height obtained from wave modeling is validated with the available BUOY and ADCP data of the year 2016 which is presented in **Fig.55 and 56.**

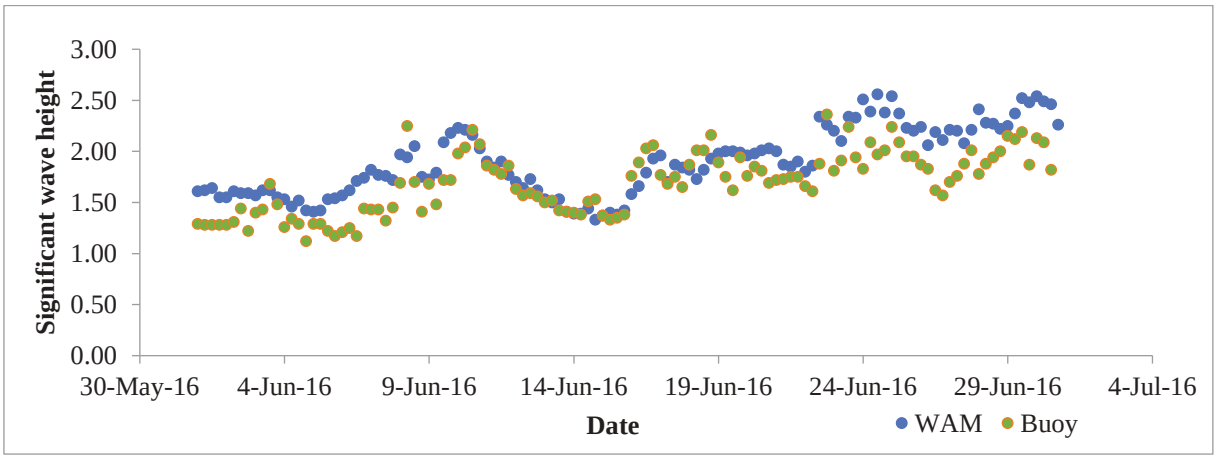


Fig.55 Significant wave height during June 2016 with BUOY data

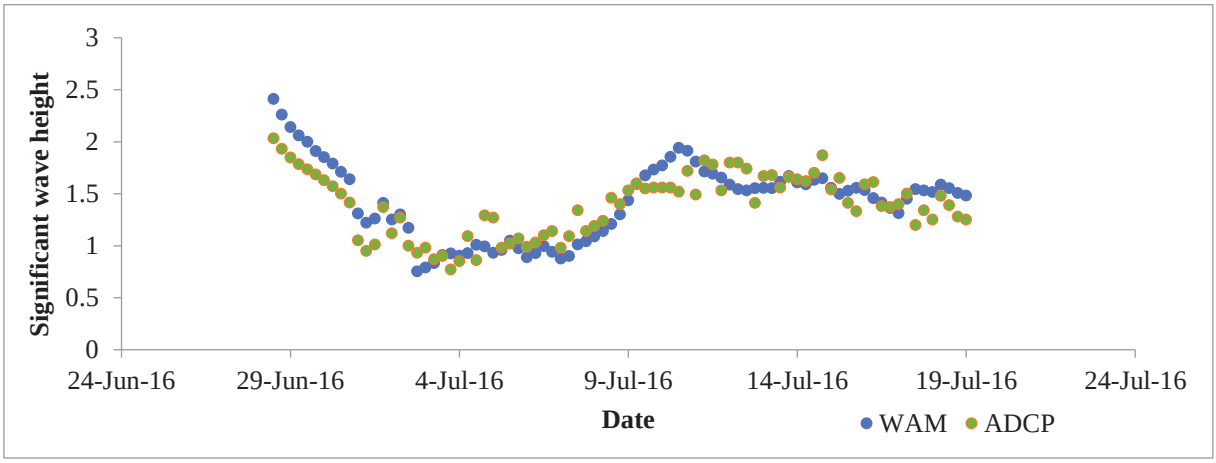


Fig.56 Significant wave height during July 2016 with ADCP data

8.0 LITTORAL DRIFT ESTIMATE

8.1 Distribution of Sediment Transport

The wave characteristics viz., significant wave height, mean wave period and mean wave direction at a deep-water location off Vypin to Munambam, at Valappu Beach, Elamkunnapuzha Beach, Njarackal Arattuvazhi Beach, Veliyatham Parambu Beach, Edavankkadu Grama Panchayat, Saidh Mohammed Beach, Kuzhippilly, Pallipuram Raktheswari beach, Cherai beach, Arattu Kadavu beach Kerala have been extracted at every 6 hours interval from the European Centre for Medium-Range Weather Forecasts (ECMWF). **Table 13** and **Table 14** shows the offshore wave characteristics adopted for the present study. These are offshore wave climates and are transformed to the near shore location of the coast using Snell's law. The average breaking wave characteristics were derived from the available wave data.

Further, the derived wave characteristics were used to calculate the long shore sediment transport. Three different methods CERC (1984), Komar (1976a), and by integrating the distribution across the surf zone (Komar, 1976b) have been adopted to calculate the alongshore sediment transport rate.

Table.13 Wave characteristics adopted for the sites from Valappu beach Beach to Pallipuram Raktheswari Beach

Month	Deep water wave direction (θ_o) w.r.t North	Wave height, H(m)	Wave period, T(sec)
January	225	0.5	5.0
February	275	0.5	6.8
March	294	0.6	5.8
April	208	0.6	7.2
May	208	0.9	7.9
June	273	2.0	9.3
July	274	2.6	9.1
August	277	1.7	8.2
September	263	1.1	6.9
October	204	0.8	8.0
November	209	0.7	7.5
December	200	0.7	7.5

Table.14 Wave characteristics adopted for Cherai and Arattu Kadavu beach

Month	Deep water wave direction (θ_o) w.r.t North	Wave height, H(m)	Wave period, T(sec)
January	221	0.4	4.8
February	218	0.5	6.9
March	254	0.6	6.6
April	207	0.6	6.9
May	208	0.8	7.9
June	266	1.8	8.6
July	269	2.4	9.1
August	271	1.5	8.6
September	258	1	6.8
October	217	0.8	7.9
November	208	0.6	8

December	204	0.6	7.8

8.2 Results on the Littoral Drift Estimate Valappu Beach

The monthly distribution of mean breaker wave height for the study area is shown in **Fig.57a**. The results indicate that the mean breaker height varies from about 0.6 m to 2.9 m. The breaker height is observed to be a maximum during the month of July. The monthly distribution of the mean breaker wave angle with respect to shore normal is shown in **Fig.57b**. From the results, it is seen that for the study area, the breaker angle with respect to shore normal and longshore current velocity are directed towards North in January, April, May and October to December and towards South in February, march and to June to September. The average surf width in which the long shore drift is predominant is further estimated from the breaker wave height for the given bathymetry and is projected in **Fig.57c** for the different months. It shows that the maximum surf width of about 175 m occurs during the month of July.

The average sediment transport rate for the different months is shown in **Fig.57d.** All three methods have yielded a similar order sediment transport rate. The net drift is found to be about -134255.841m^3 per annum and directed towards the North as shown in **Table.15.**

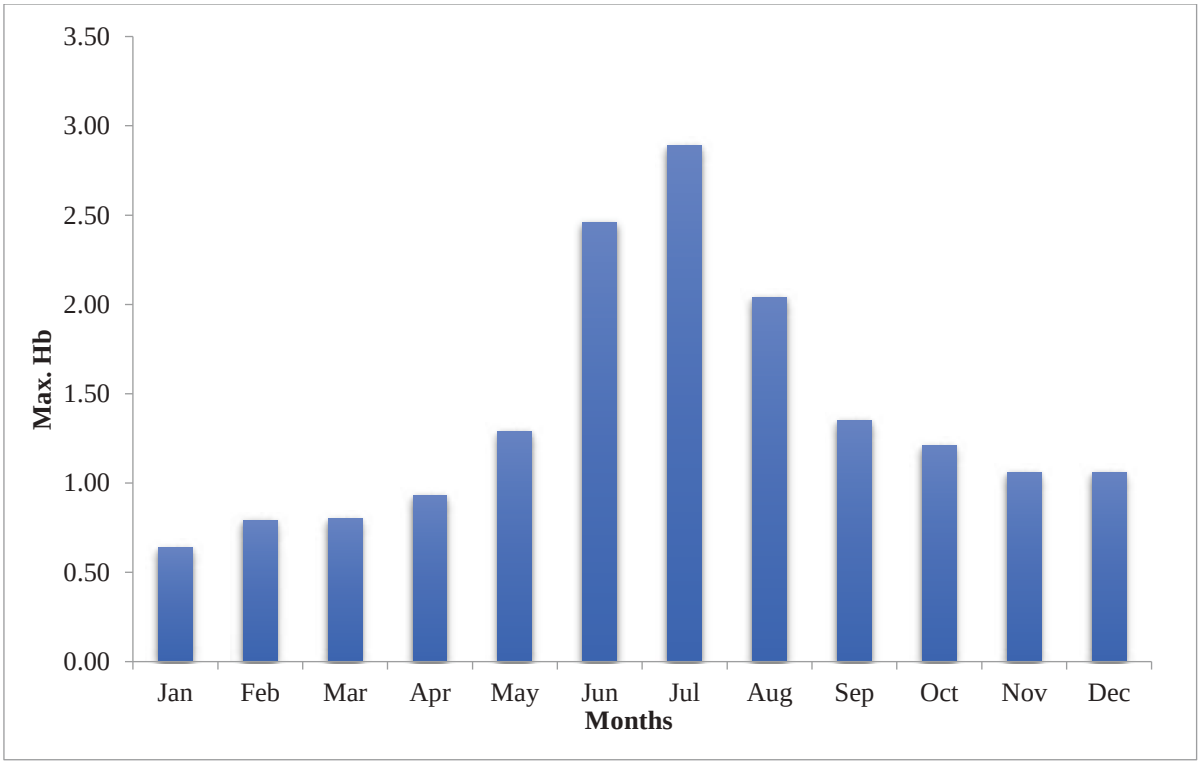


Fig.57a Breaker wave heights of Valappu Beach

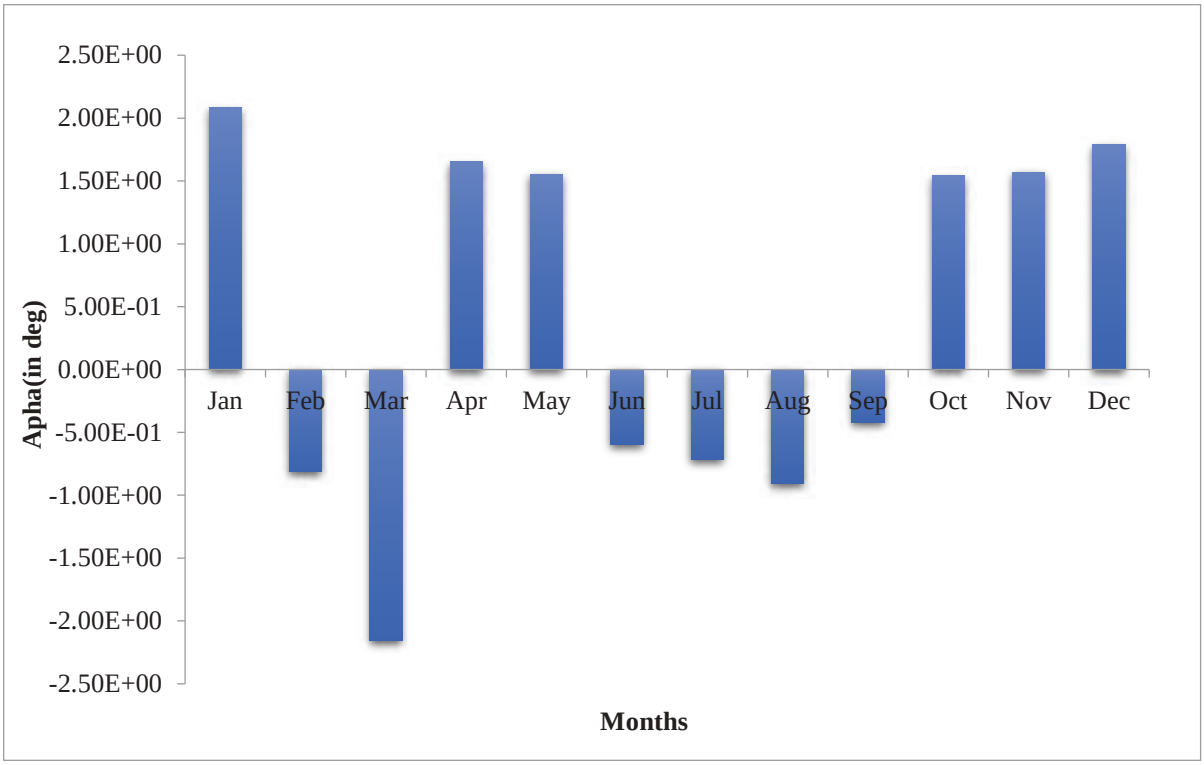


Fig.57b Wave breaker angle of Valappu Beach

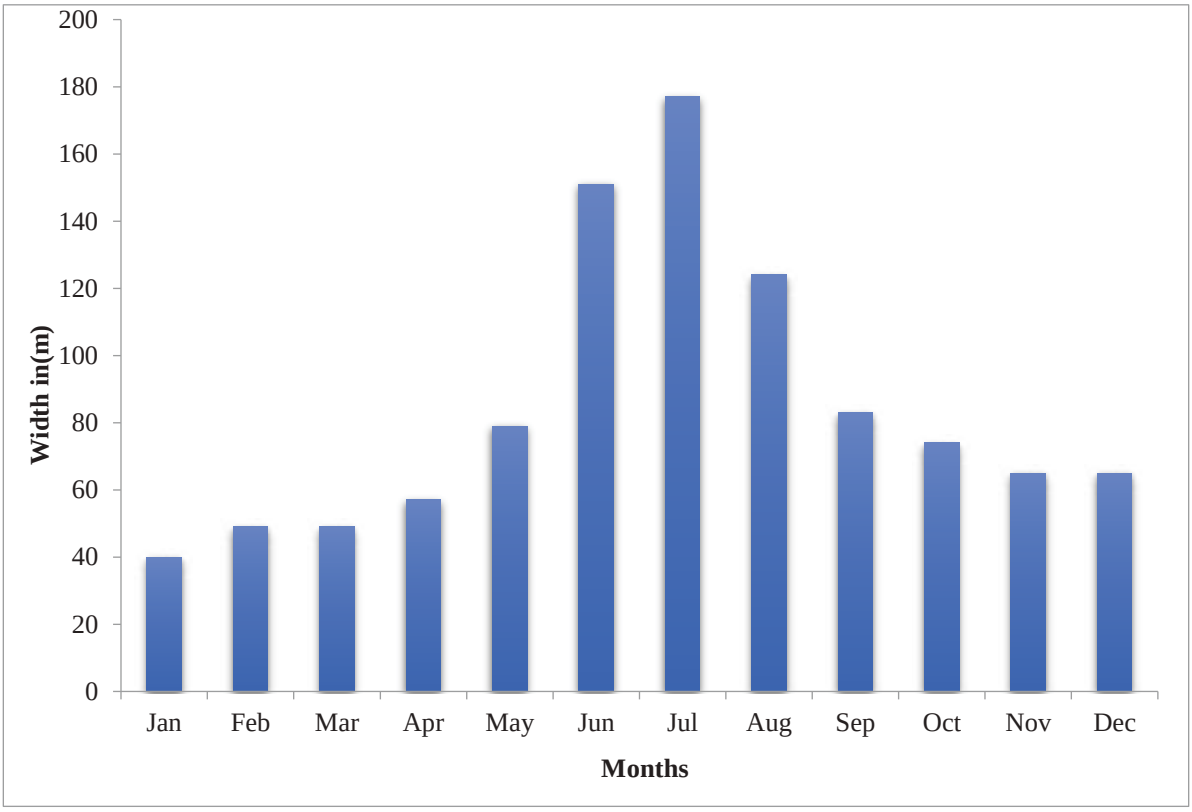


Fig.57c Surf zone width of Valappu Beach

Table.15 Sediment transport rate of Valappu Beach

Methods	Rate (m^3/year)
Komar	-132350
CERC	-137851
Distribution	-132566

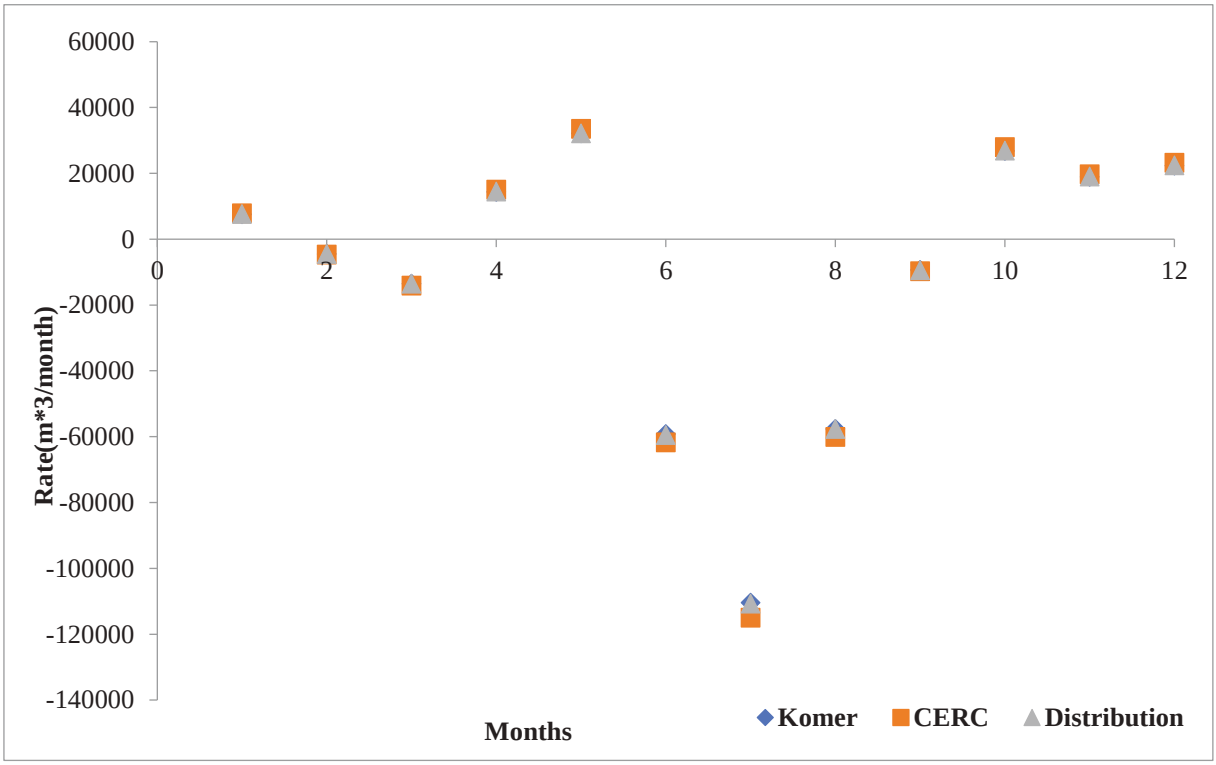


Fig.57d Longshore Sediment transport rate of Valappu Beach

8.3 Results on the Littoral Drift Estimate Elamkunnapuzha Beach

The monthly distribution of mean breaker wave height for the study area is shown in **Fig.58a**. The results indicate that the mean breaker height varies from about 0.6 m to 2.9 m. The breaker height is observed to be a maximum during the month of July. The monthly distribution of the mean breaker wave angle with respect to shore normal is shown in **Fig.58b**. From the results it is seen that for the study area, the breaker angle with respect to shore normal and longshore current velocity are directed towards North in January, April, May and October to December and towards South in February, march and to June to September. The average surf width in which the long shore drift is predominant is further estimated from the breaker

wave height for the given bathymetry and is projected in **Fig.58c** for the different months. It shows that the maximum surf width of about 175 m occurs during the month of July.

The average sediment transport rate for the different months is shown in **Fig.58d**. All the three methods have yielded similar order sediment transport rate. The net drift is found to be about -130174.5963m^3 per annum and directed towards the North as shown in **Table.16.**

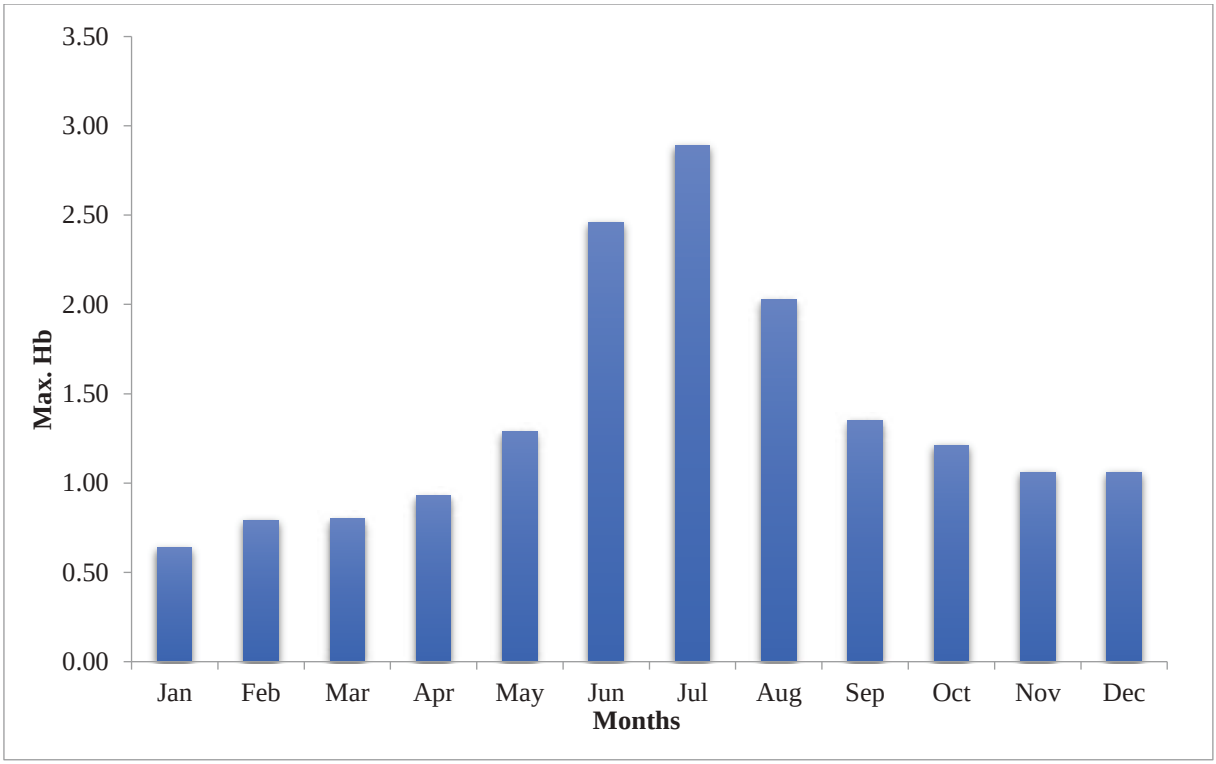


Fig.58a Breaker wave heights of Elamkunnapuzha Beach

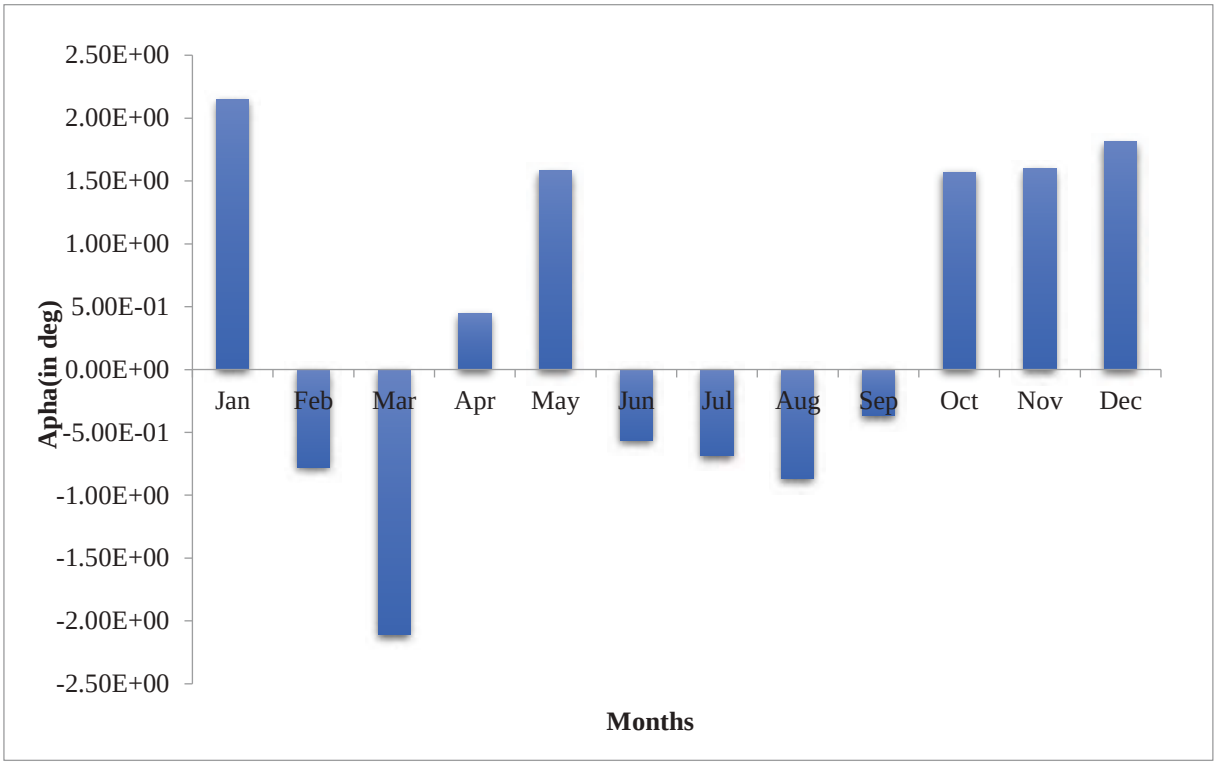


Fig.58b Wave breaker angle of Elamkunnapuzha Beach

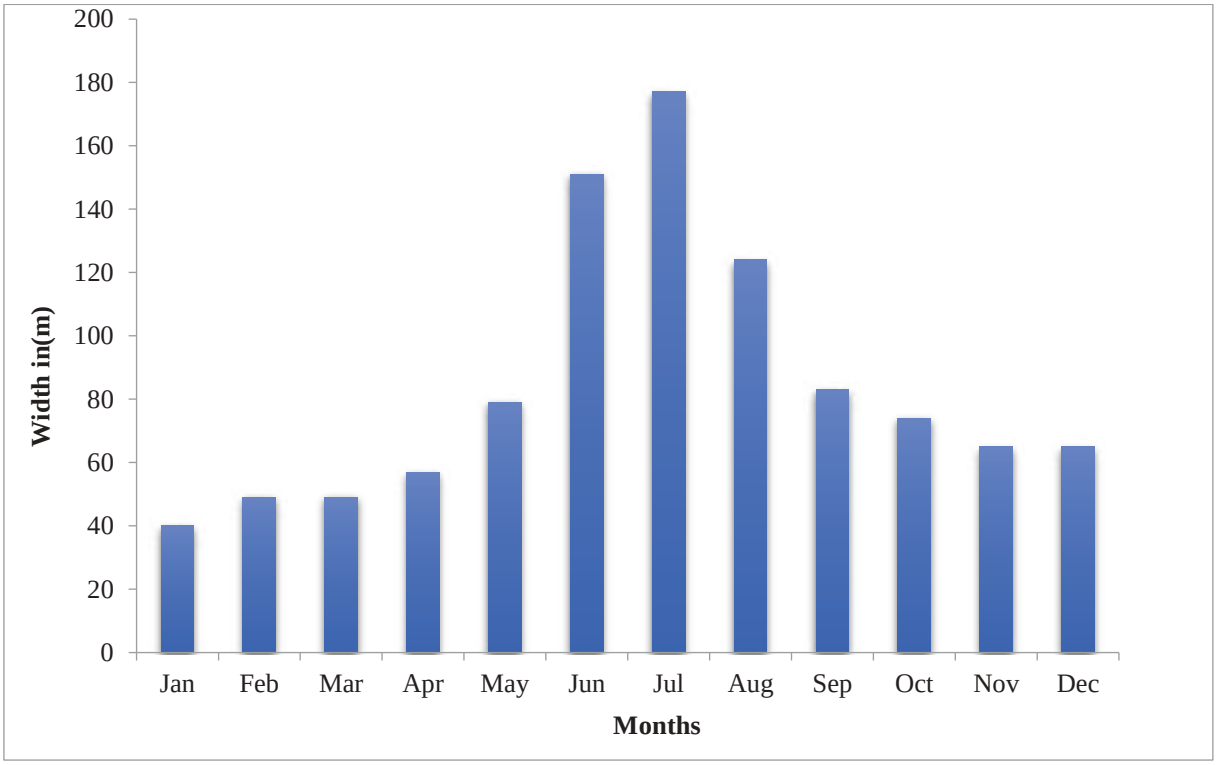


Fig.58c Surf zone width of Elamkunnapuzha Beach

Table.16 Sediment transport rate of Elamkunnapuzha Beach

Methods	Rate (m^3/year)
Komar	-128325
CERC	-133658
Distribution	-128541

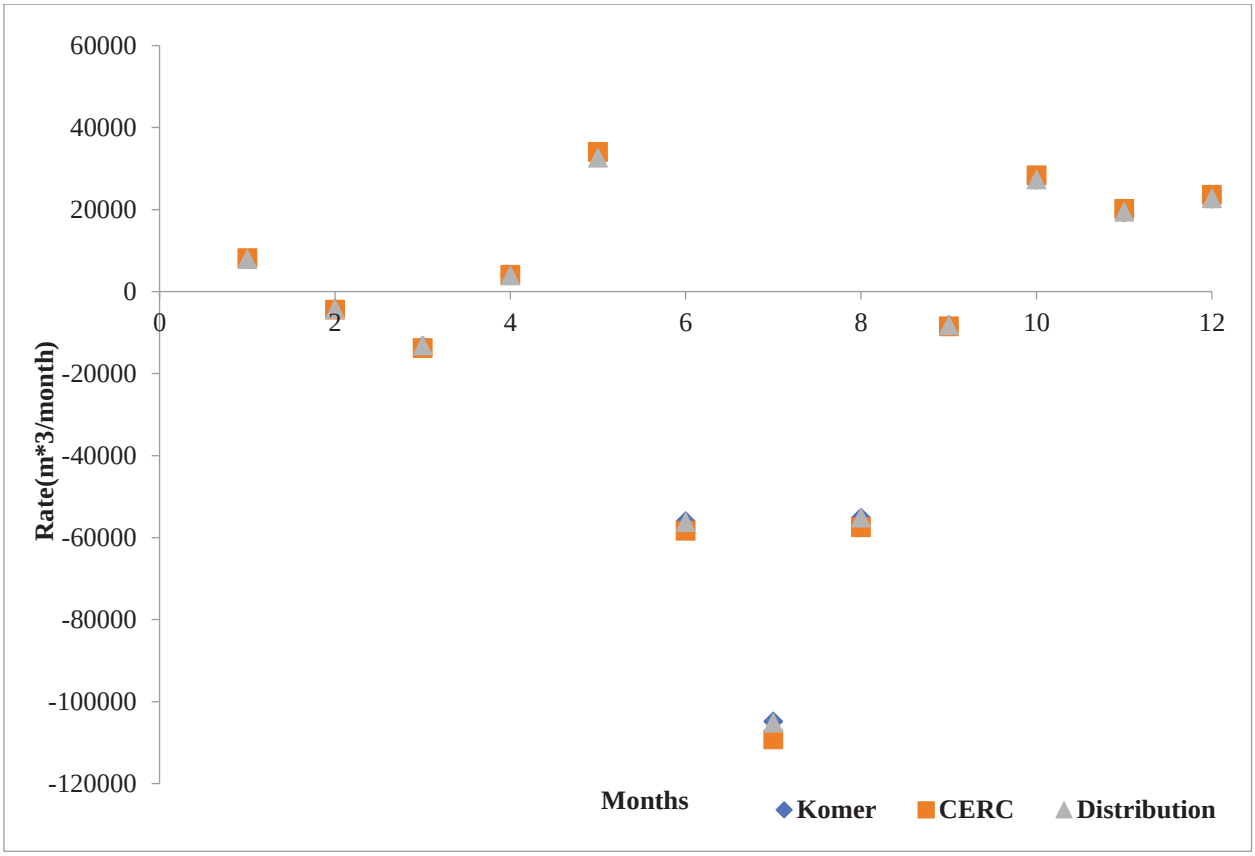


Fig.58d Longshore Sediment transport rate of Elamkunnapuzha Beach

8.4 Results on the Littoral Drift Estimate Njarackal Arattuvazhi Beach

The monthly distribution of mean breaker wave height for the study area is shown in **Fig.59a**. The results indicate that the mean breaker height varies from about 0.6 m to 2.9 m. The breaker height is observed to be a maximum during the month of July. The monthly distribution of the mean breaker wave angle with respect to shore normal is shown in **Fig.59b**. From the results it is seen that for the study area, the breaker angle with respect to shore normal and longshore current velocity are directed towards North in January , April , May and October to December and towards South in February , march and to June to September**.** The average surf width in which the long shore drift is predominant is further estimated from the breaker

wave height for the given bathymetry and is projected in **Fig.59c** for the different months**.** It shows that the maximum surf width of about 175 m occurs during the month of July.

The average sediment transport rate for the different months is shown in **Fig.59d**. All the three methods have yielded similar order sediment transport rate. The net drift is found to be about -134255 m^3 per annum and directed towards the south as shown in **Table.17.**

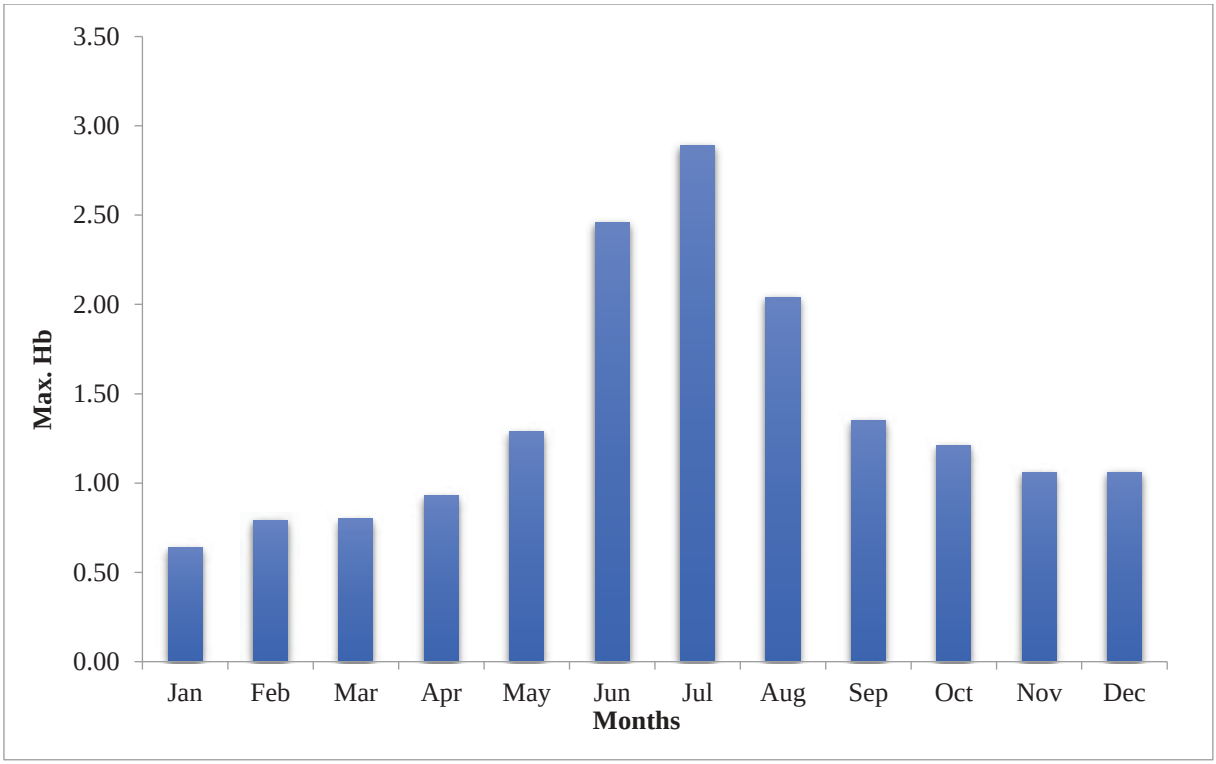


Fig.59a Breaker wave heights of Njarackal arattuvazhi beach

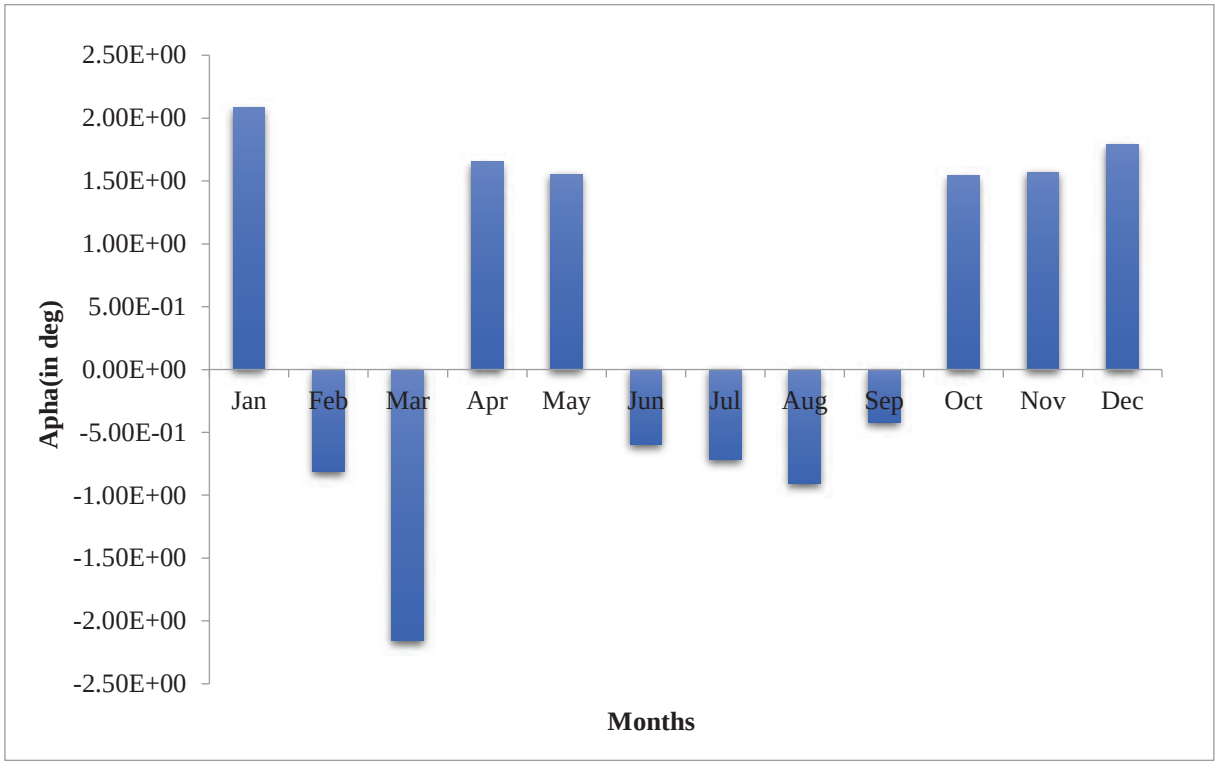


Fig.59b Wave breaker angle of Njarackal arattuvazhi beach

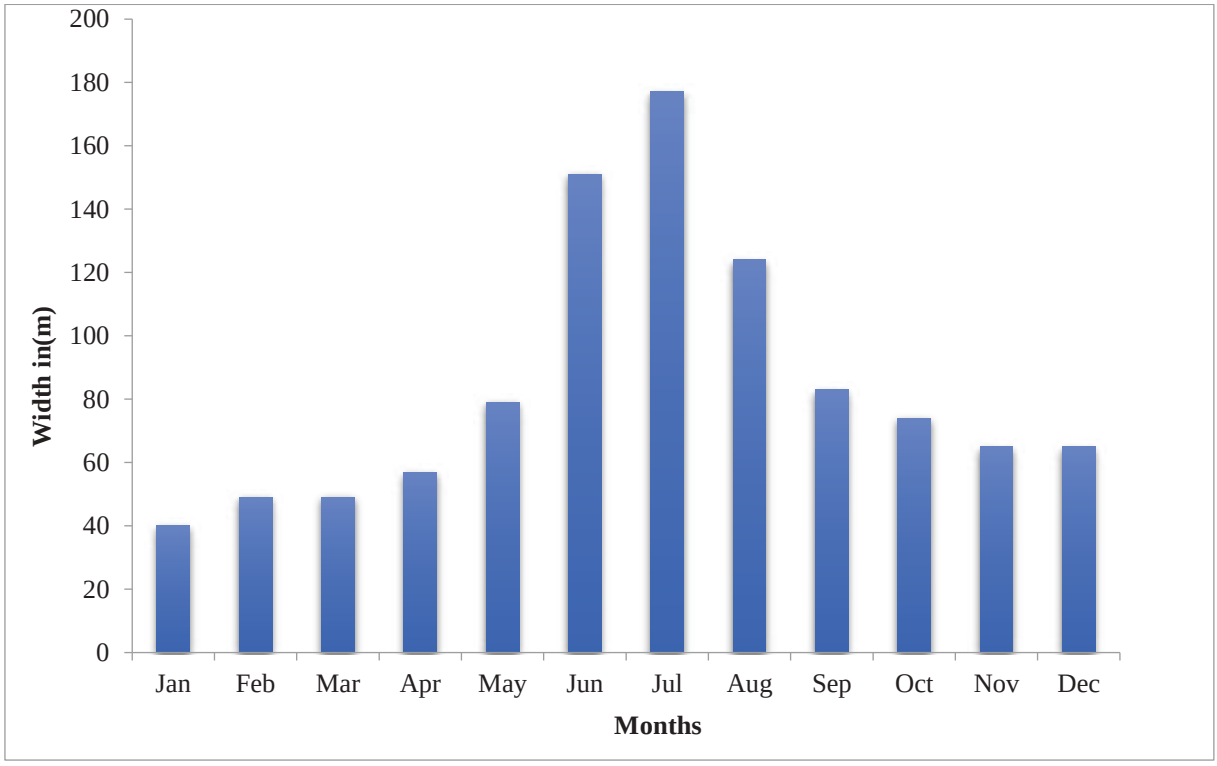


Fig.59c Surf zone width of Njarackal arattuvazhi beach

Table.17 Sediment transport rate of Njarackal arattuvazhi beach

Methods	Rate (m^3/year)
Komar	-132351
CERC	-137851
Distribution	-132566

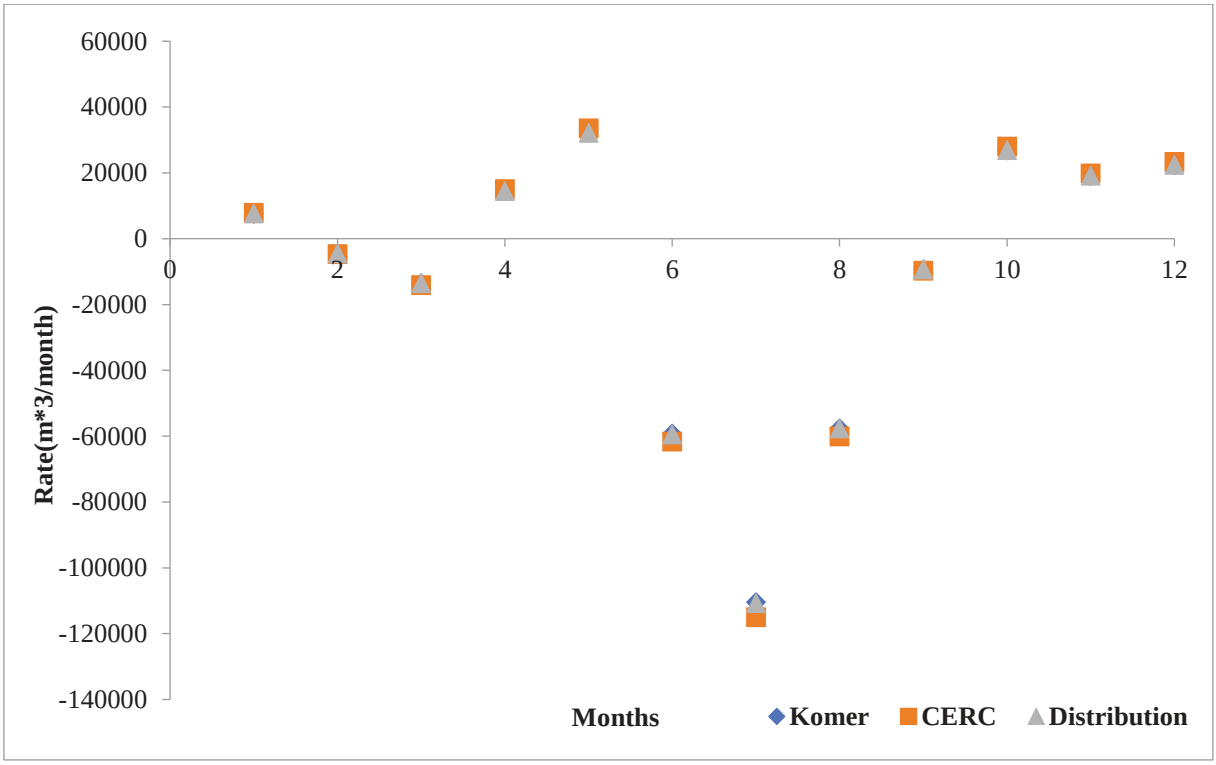


Fig.59d Longshore Sediment transport rate of Njarackal arattuvazhi beach

8.5 Results on the Littoral Drift Estimate Veliyatham Parambu Beach

The monthly distribution of mean breaker wave height for the study area is shown in **Fig.60a.** The results indicate that the mean breaker height varies from about 0.6 m to 2.9 m. The breaker height is observed to be a maximum during the month of July. The monthly distribution of the mean breaker wave angle with respect to shore normal is shown in **Fig.60b.** From the results it is seen that for the study area, the breaker angle with respect to shore normal and longshore current velocity are directed towards North in January, April , May and October to December and towards South in February , march and to June to September. The average surf width in which the long shore drift is predominant is further estimated from the breaker

wave height for the given bathymetry and is projected in **Fig.60c** for the different months. It shows that the maximum surf width of about 175 m occurs during the month of July.

The average sediment transport rate for the different months is shown in **Fig.60d.** All the three methods have yielded similar order sediment transport rate. The net drift is found to be about -57441m^3 per annum and directed towards the south as shown in **Table.18.**

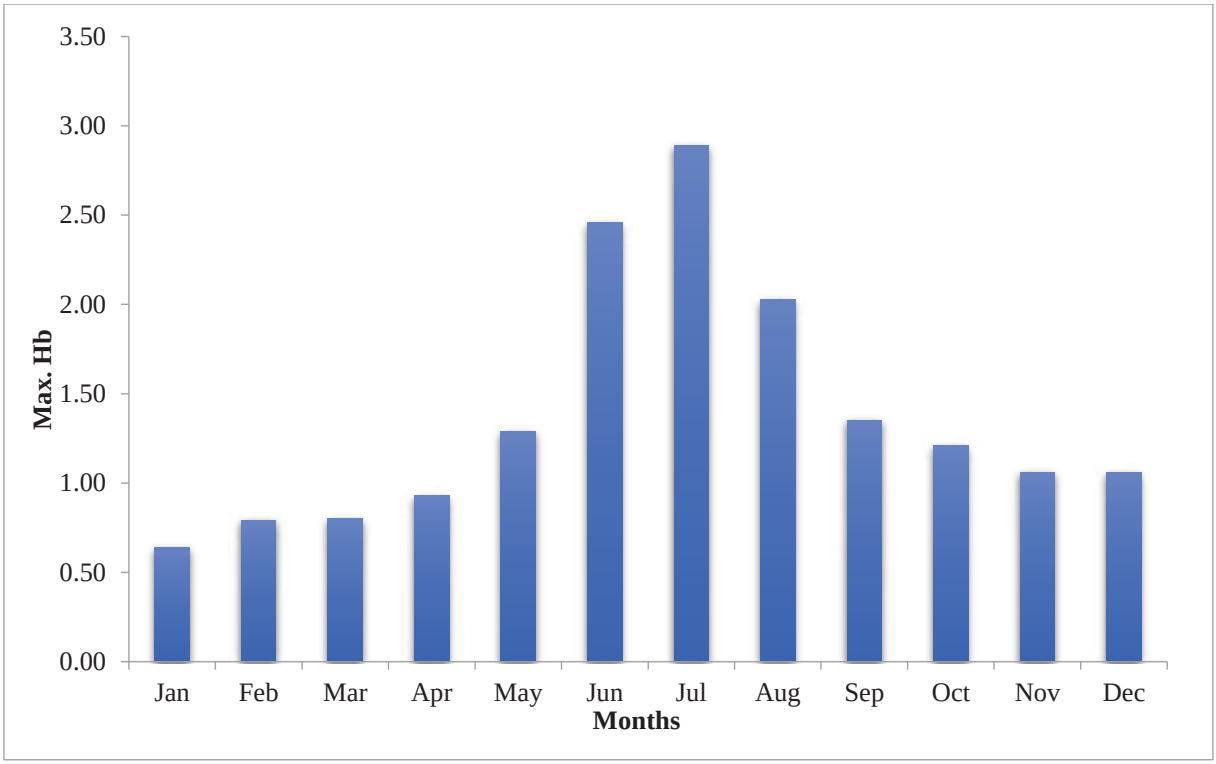


Fig.60a Breaker wave heights of Veliyatham Parambu Beach

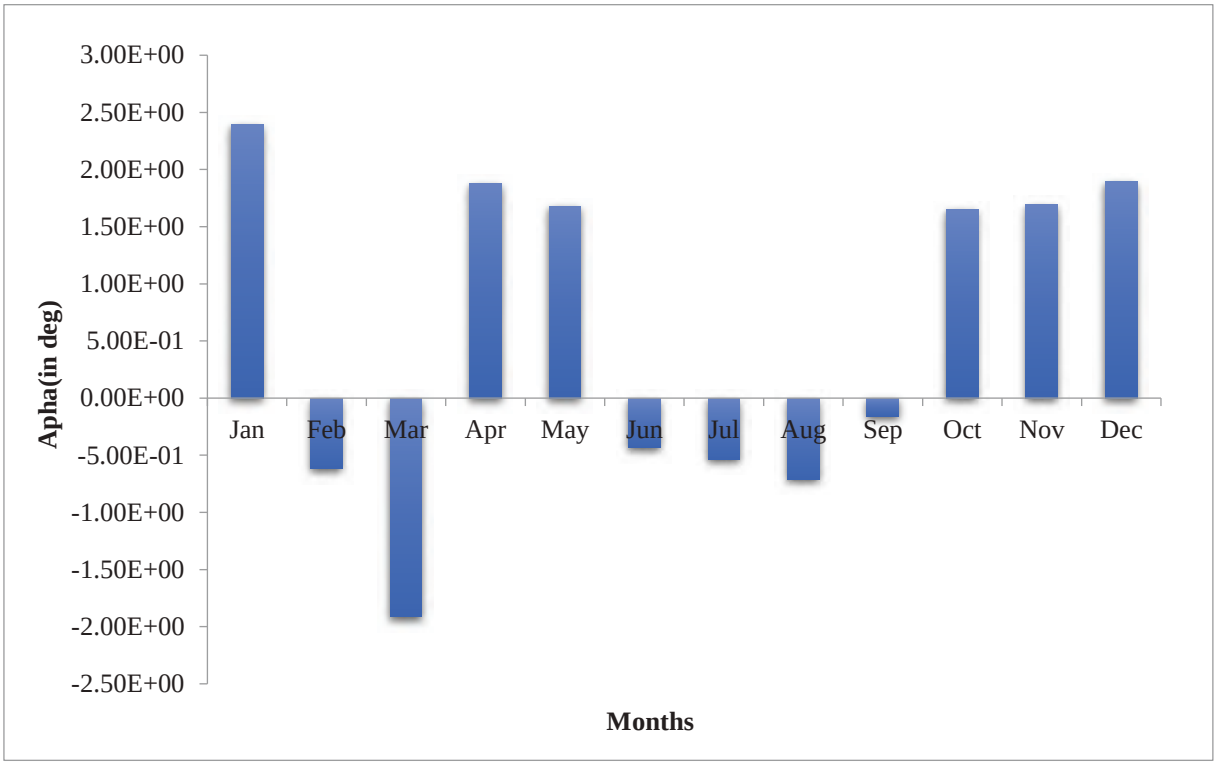


Fig.60b Wave breaker angle of Veliyatham Parambu Beach

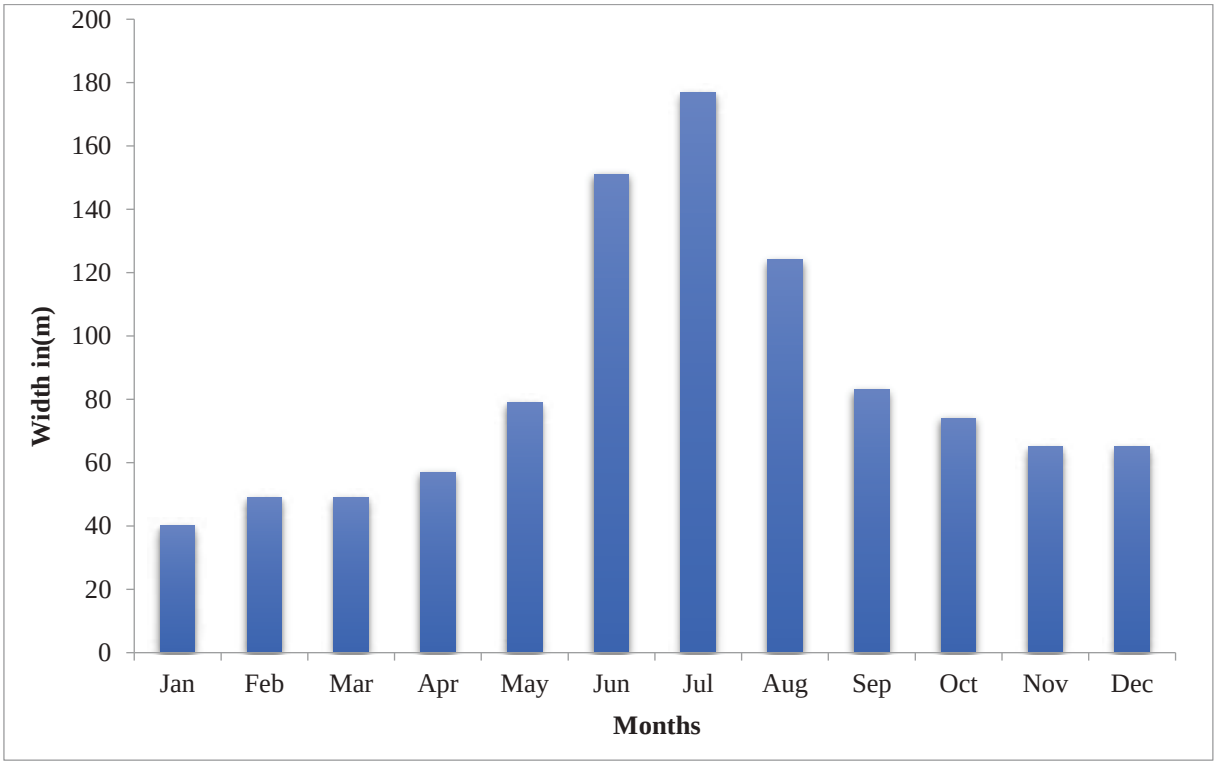


Fig.60c Surf zone width of Veliyatham Parambu Beach

Table. 18. Sediment transport rate of Veliyatham Parambu Beach

Methods	Rate (m^3/year)
Komar	-56661.6
CERC	-59016.4
Distribution	-56644.1

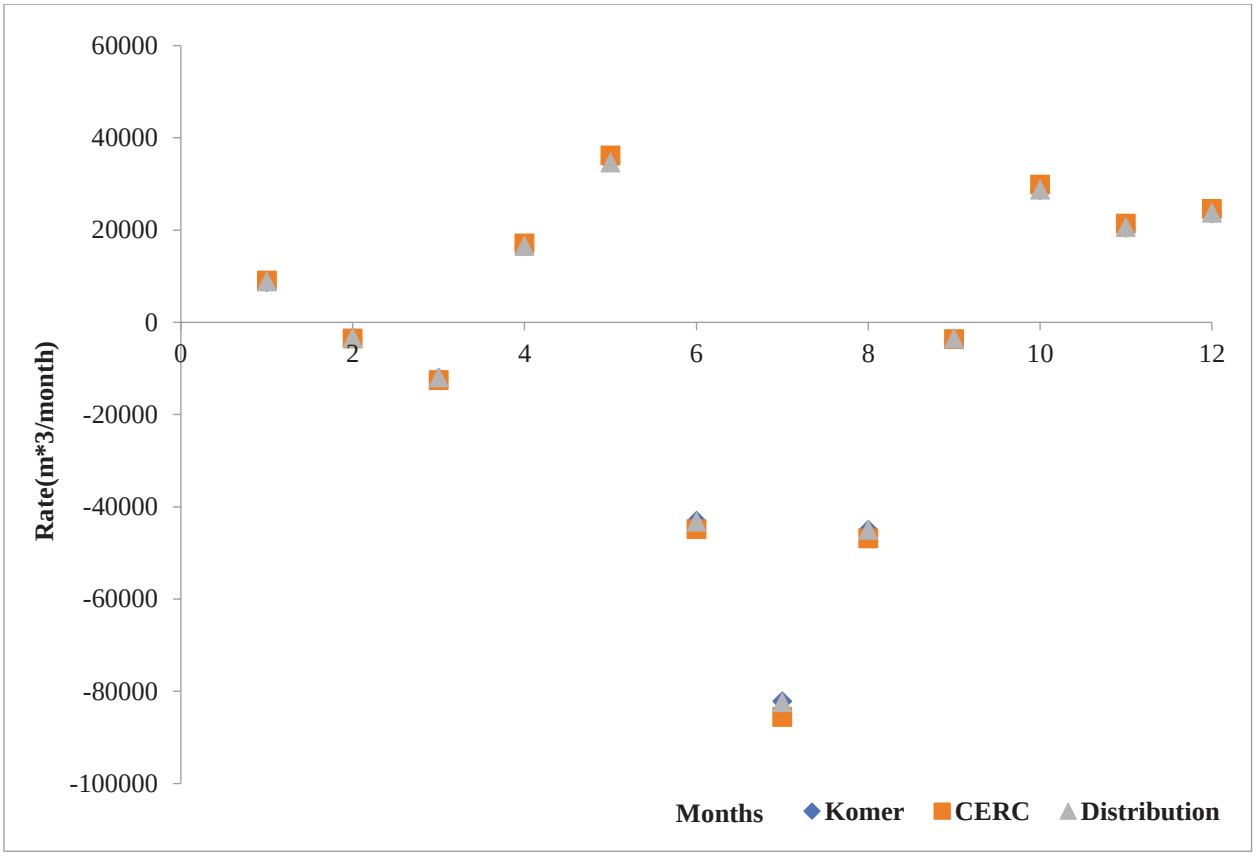


Fig.60d Longshore Sediment transport rate of Veliyatham Parambu Beach

8.6 Results on the Littoral Drift Estimate Edavankkadu Grama Panchayat

The monthly distribution of mean breaker wave height for the study area is shown in **Fig.61a.** The results indicate that the mean breaker height varies from about 0.6 m to 2.9 m. The breaker height is observed to be a maximum during the month of July. The monthly distribution of the mean breaker wave angle with respect to shore normal is shown in **Fig.61b.** From the results it is seen that for the study area, the breaker angle with respect to shore normal and longshore current velocity are directed towards North in January , April , May and October to December and towards South in February , march and to June to September. The average surf width in which the long shore drift is predominant is further estimated from the breaker

wave height for the given bathymetry and is projected in **Fig.61c** for the different months**.** It shows that the maximum surf width of about 175 m occurs during the month of July.

The average sediment transport rate for the different months is shown in **Fig.61d**. All the three methods have yielded similar order sediment transport rate. The net drift is found to be about -73700 m^3 per annum and directed towards the North as shown in **Table.19.**

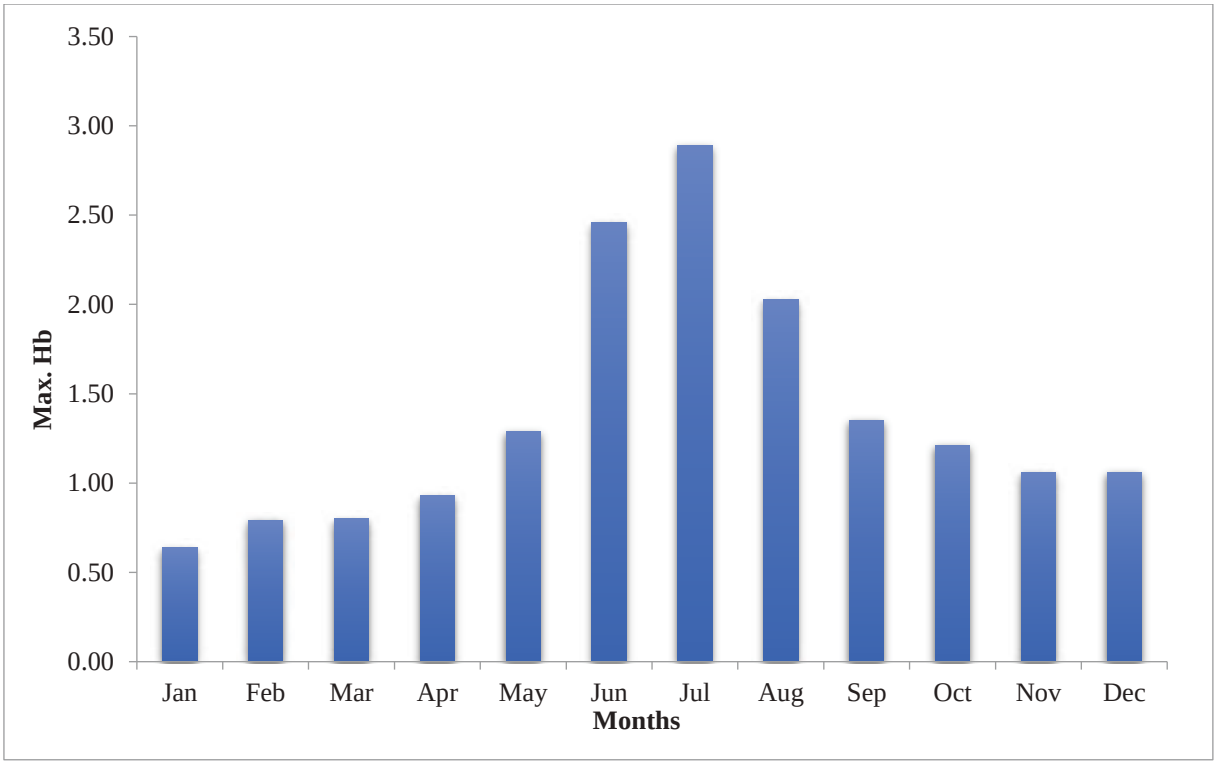


Fig.61a Breaker wave heights of Edavankkadu Grama Panchayat

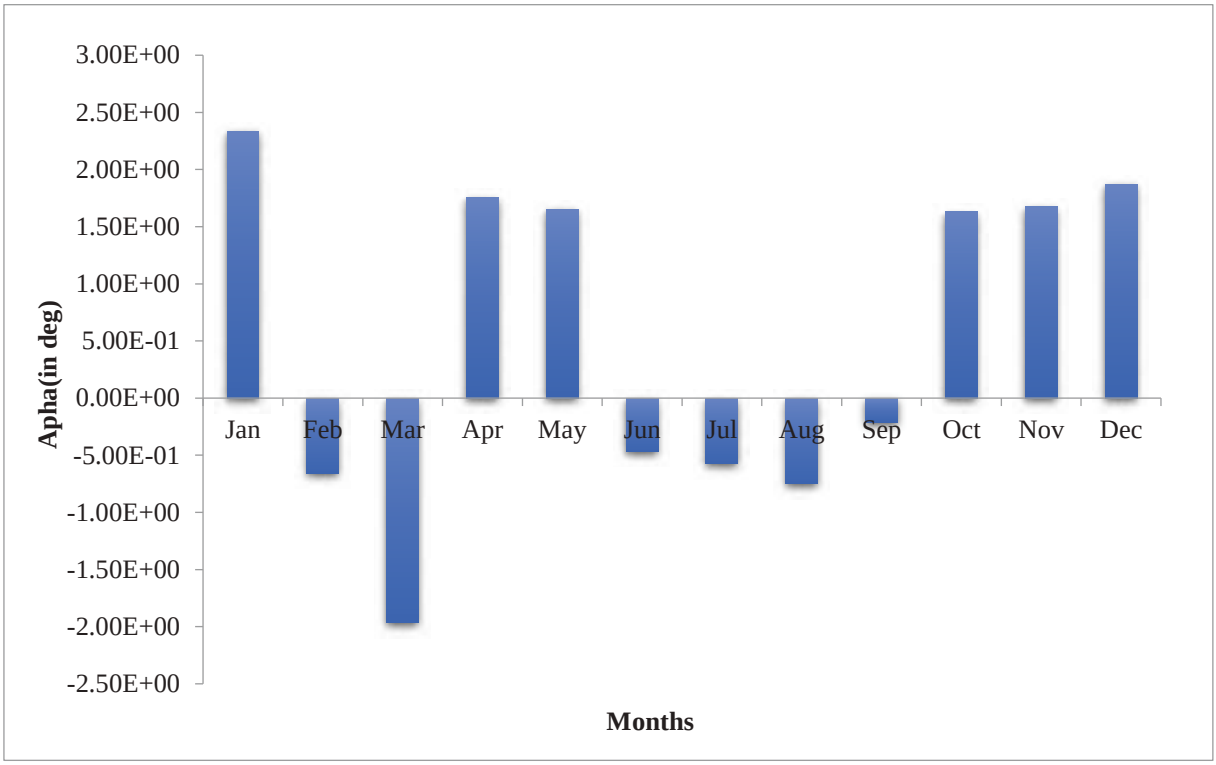


Fig.61b Wave breaker angle of Edavankkadu Grama Panchayat

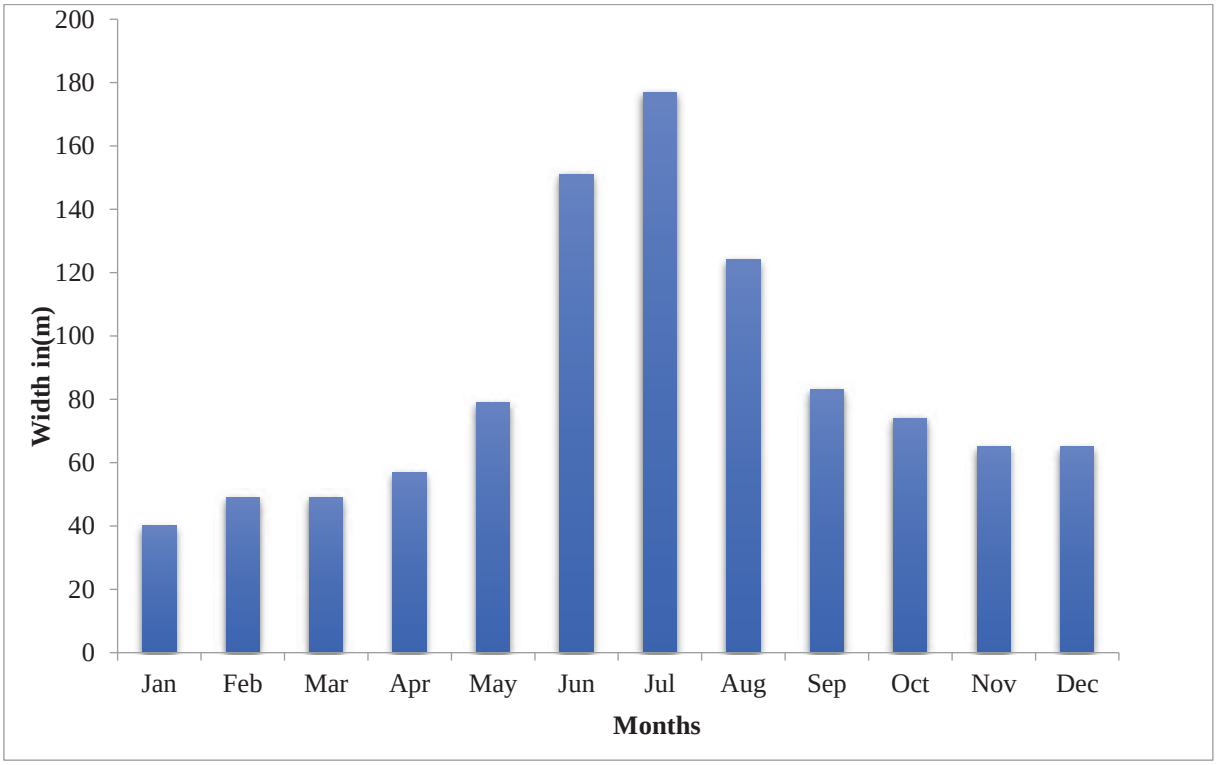


Fig.61c Surf zone width of Edavankkadu Grama Panchayat

Table.19 Sediment transport rate of Edavankkadu Grama Panchayat

Methods	Rate (m^3/year)
Komar	-72682.8
CERC	-75703.4
Distribution	-72715.2

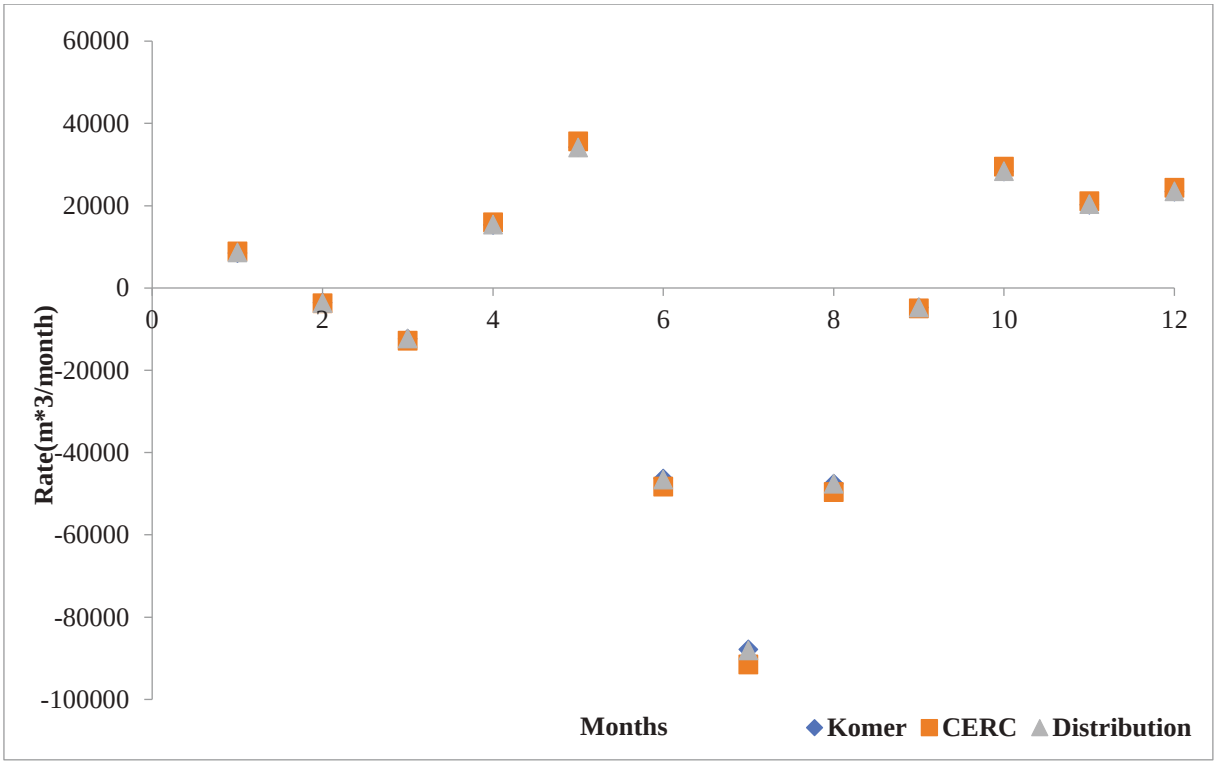


Fig.61d Longshore Sediment transport rate of Edavankkadu Grama Panchayat

8.7 Results on the Littoral Drift Estimate Saidh Mohammed Beach

The monthly distribution of mean breaker wave height for the study area is shown in **Fig.62a**. The results indicate that the mean breaker height varies from about 0.64 m to 2.89 m. The breaker height is observed to be a maximum during the month of July. The monthly distribution of the mean breaker wave angle with respect to shore normal is shown in **Fig.62b**. From the results it is seen that for the study area, the breaker angle with respect to shore normal and longshore current velocity are directed towards North in January , April , May and October to December and towards South in February , march and to June to September. The average surf width in which the long shore drift is predominant is further estimated from the breaker

wave height for the given bathymetry and is projected in **Fig.62c** for the different months**.** It shows that the maximum surf width of about 177 m occurs during the month of July.

The average sediment transport rate for the different months is shown in **Fig.62d**. All the three methods have yielded similar order sediment transport rate. The net drift is found to be about -43174 m^3 per annum and directed towards the south as shown in **Table.20.**

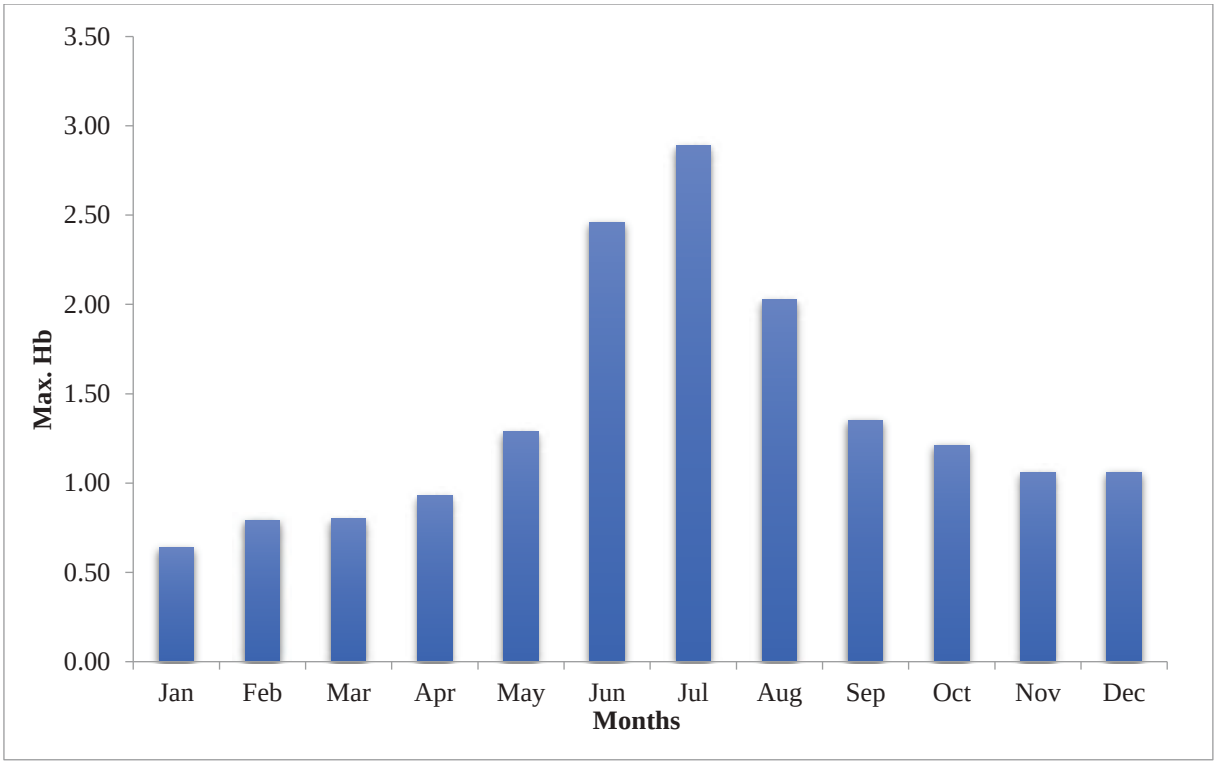


Fig.62a Breaker wave heights of Saidh Mohammed Beach

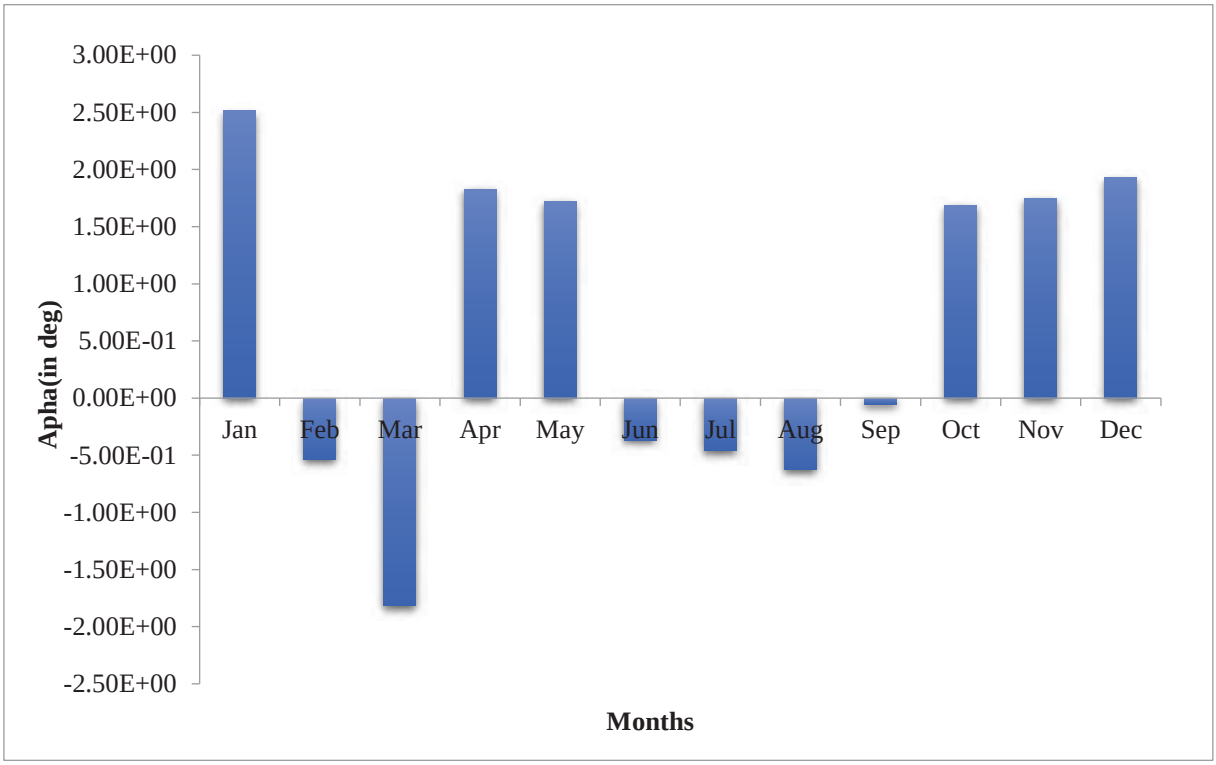


Fig.62b Wave breaker angle of Saidh Mohammed Beach

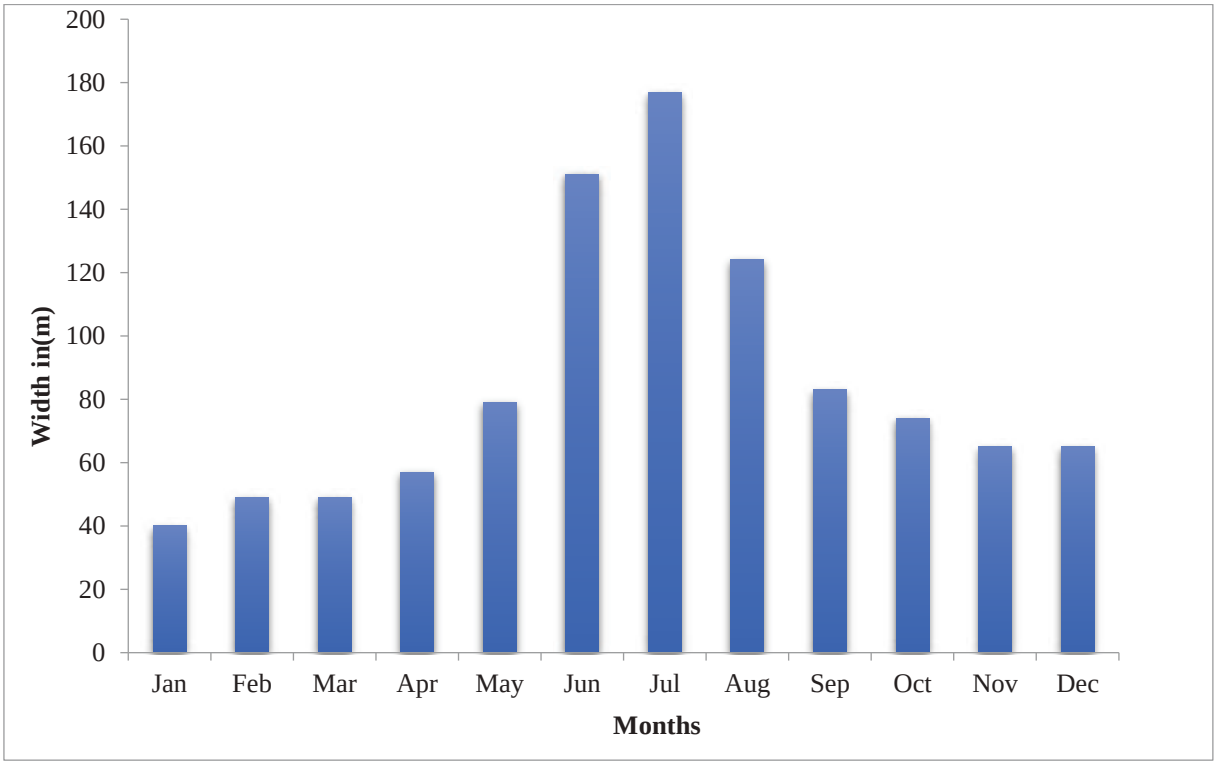


Fig.62c Surf zone width of Saidh Mohammed Beach

Table.20 Sediment transport rate of Saidh Mohammed Beach

Methods	Rate (m^3/year)
Komar	-42603.7
CERC	-44374.2
Distribution	-42544.6

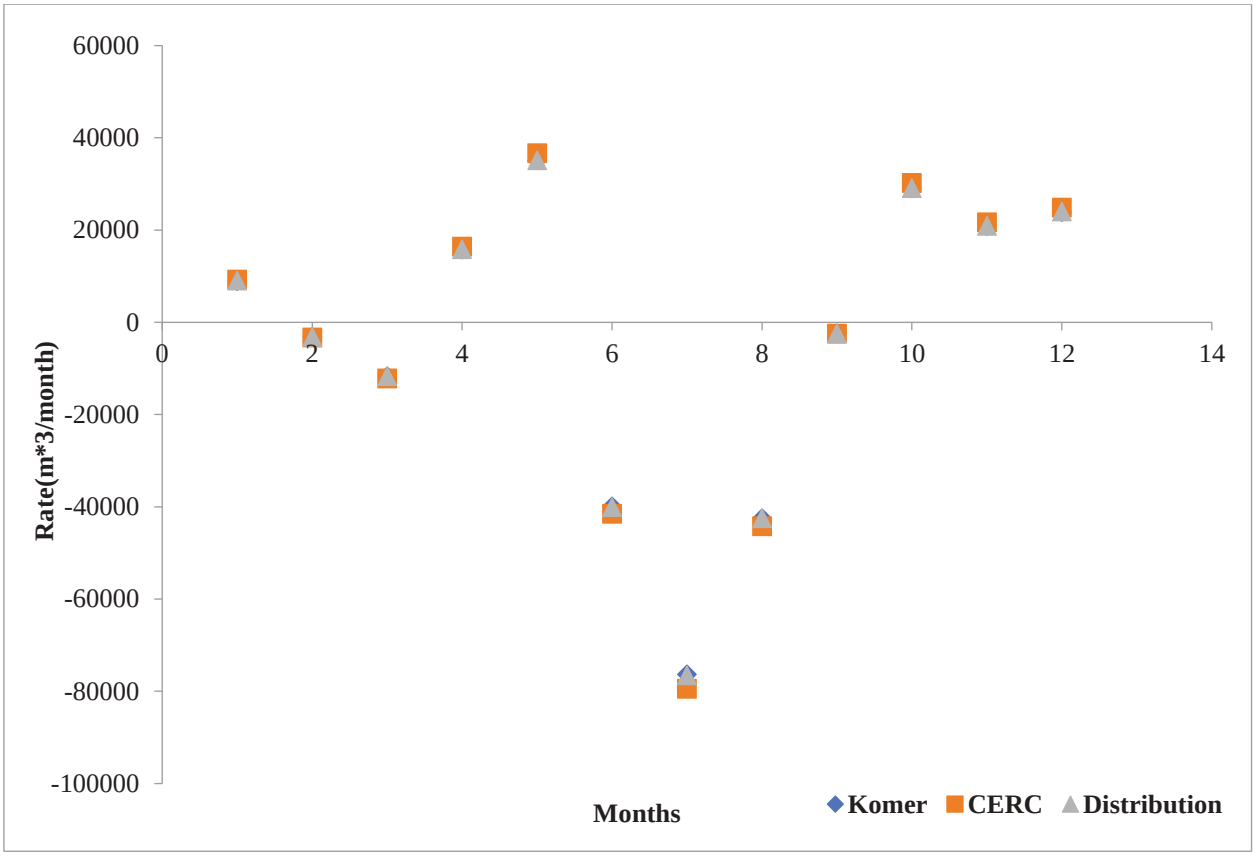


Fig.62d Longshore Sediment transport rate of Saidh Mohammed Beach

8.8 Result Littoral Drift Estimate Kuzhippilly

The monthly distribution of mean breaker wave height for the study area is shown in **Fig.63a**. The results indicate that the mean breaker height varies from about 0.64 m to 2.89 m. The breaker height is observed to be a maximum during the month of July. The monthly distribution of the mean breaker wave angle with respect to shore normal is shown in **Fig.63b**. From the results it is seen that for the study area, the breaker angle with respect to shore normal and longshore current velocity are directed towards North in January , April , May and October to December and towards South in February , march and to June to September. The average surf width in which the long shore drift is predominant is further estimated from the breaker

wave height for the given bathymetry and is projected in **Fig.63c** for the different months**.** It shows that the maximum surf width of about 177 m occurs during the month of July.

The average sediment transport rate for the different months is shown in **Fig.63d.** All the three methods have yielded similar order sediment transport rate. The net drift is found to be about -104188m^3 per annum and directed towards the south as shown in **Table.21**

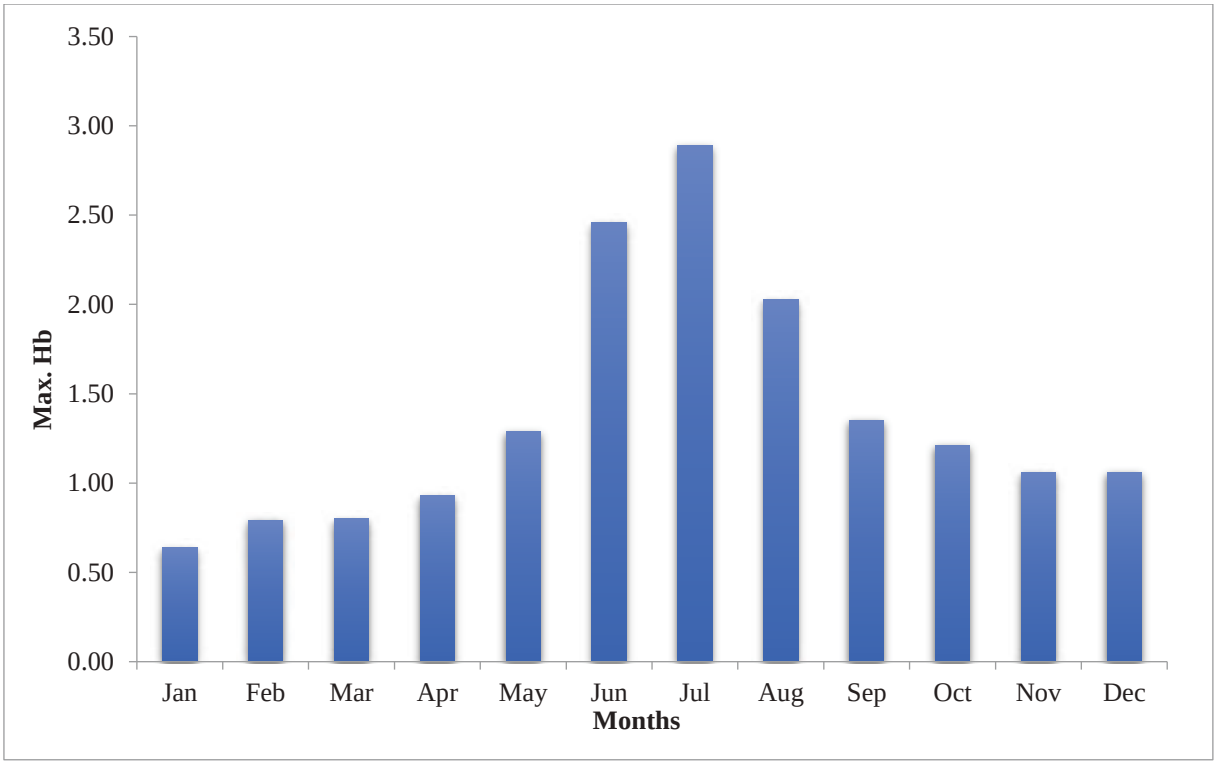


Fig.63a Breaker wave heights of Kuzhippilly

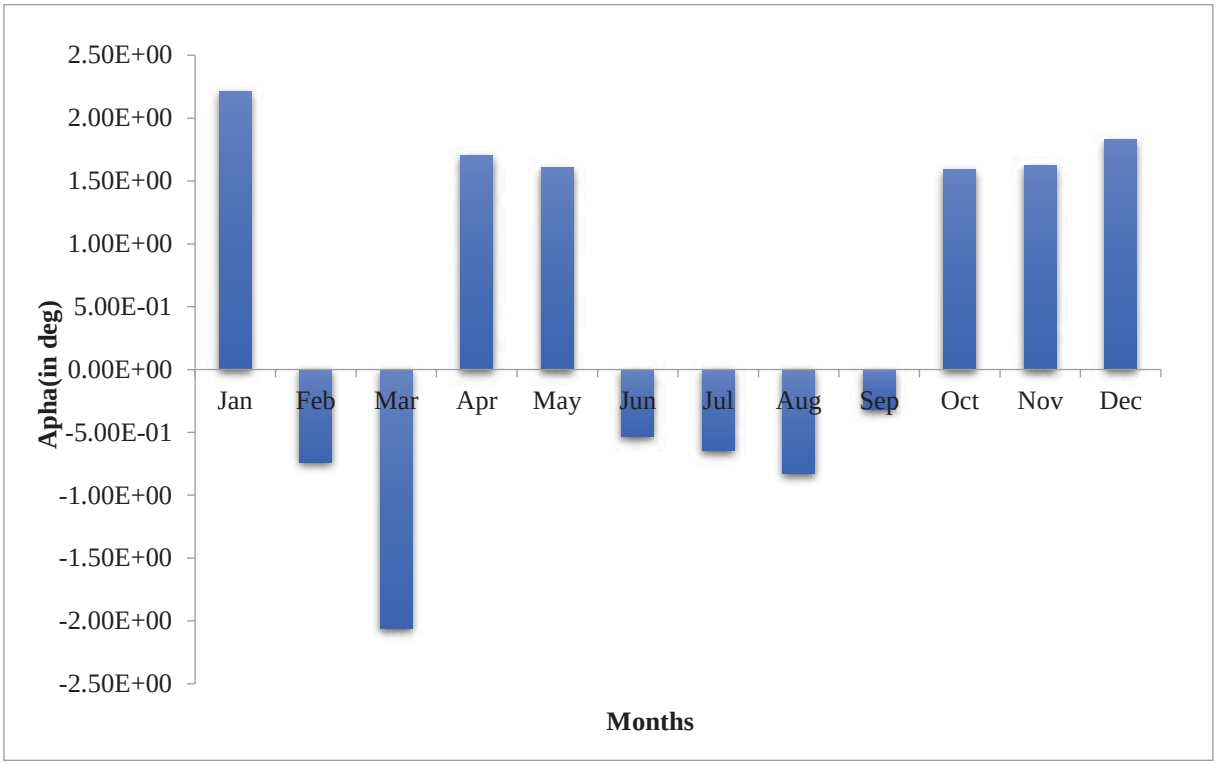


Fig.63b Wave breaker angle of Kuzhippilly

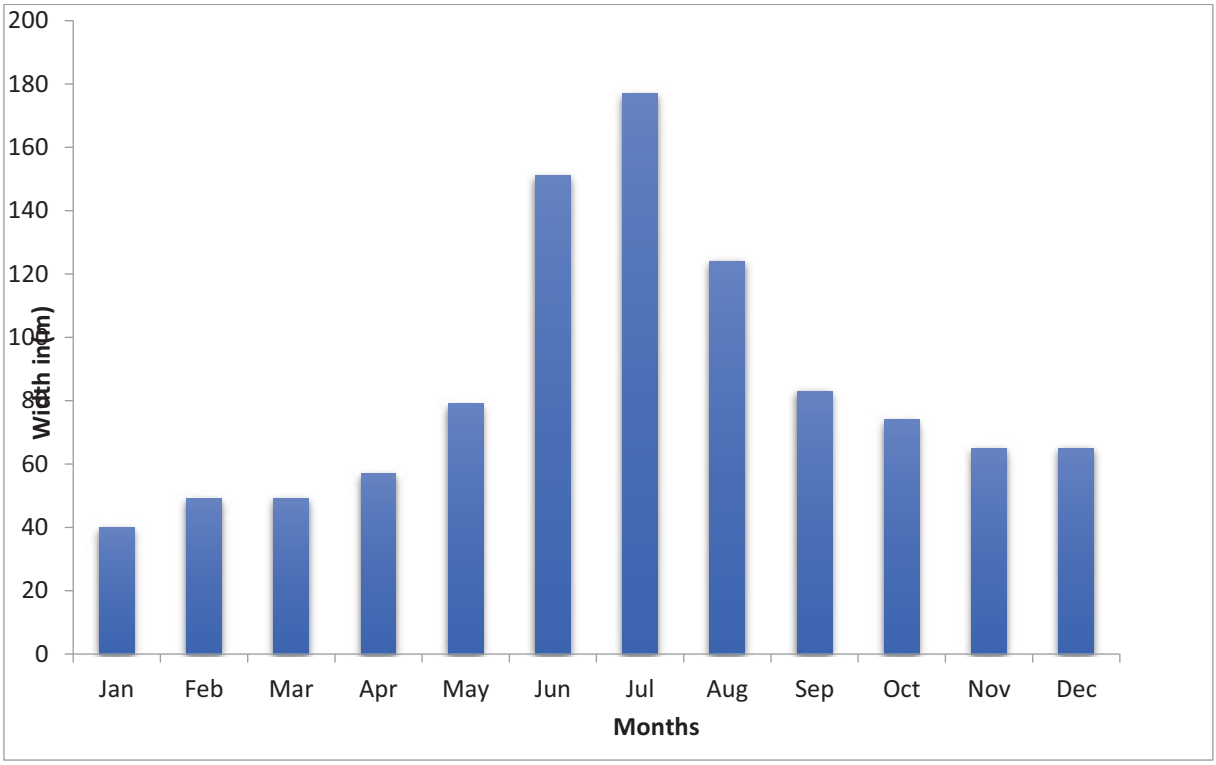


Fig.63c Surf zone width of Kuzhippilly

Table. 21 Sediment transport rate of Kuzhippilly

Methods	Rate (m^3/year)
Komar	-102724
CERC	-106993
Distribution	-102848

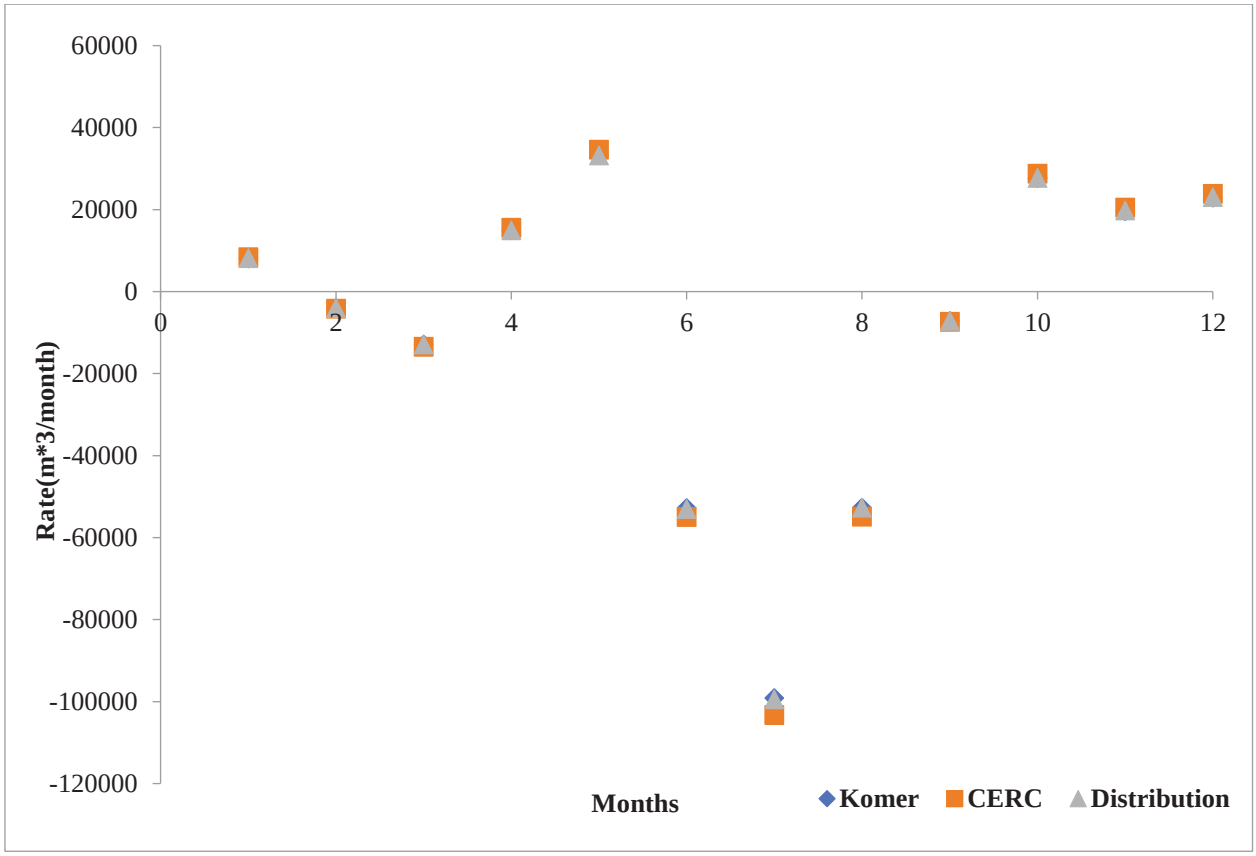


Fig.63d Longshore Sediment transport rate of Kuzhippilly

8.9 Results on the Littoral Drift Estimate Pallipuram Raktheswari Beach

The monthly distribution of mean breaker wave height for the study area is shown in **Fig.64a.** The results indicate that the mean breaker height varies from about 0.6 m to 2.9 m. The breaker height is observed to be a maximum during the month of July. The monthly distribution of the mean breaker wave angle with respect to shore normal is shown in **Fig.64b**. From the results it is seen that for the study area, the breaker angle with respect to shore normal and longshore current velocity are directed towards North in January , April , May and October to December and towards South in February , march and to June to September. The average surf width in which the long shore drift is predominant is further estimated from the breaker

wave height for the given bathymetry and is projected in **Fig.64c** for the different months**.** It shows that the maximum surf width of about 177 m occurs during the month of July.

The average sediment transport rate for the different months is shown in **Fig.64d**. All the three methods have yielded similar order sediment transport rate. The net drift is found to be about -134638 m^3 per annum and directed towards the south as shown in **Table.22.**

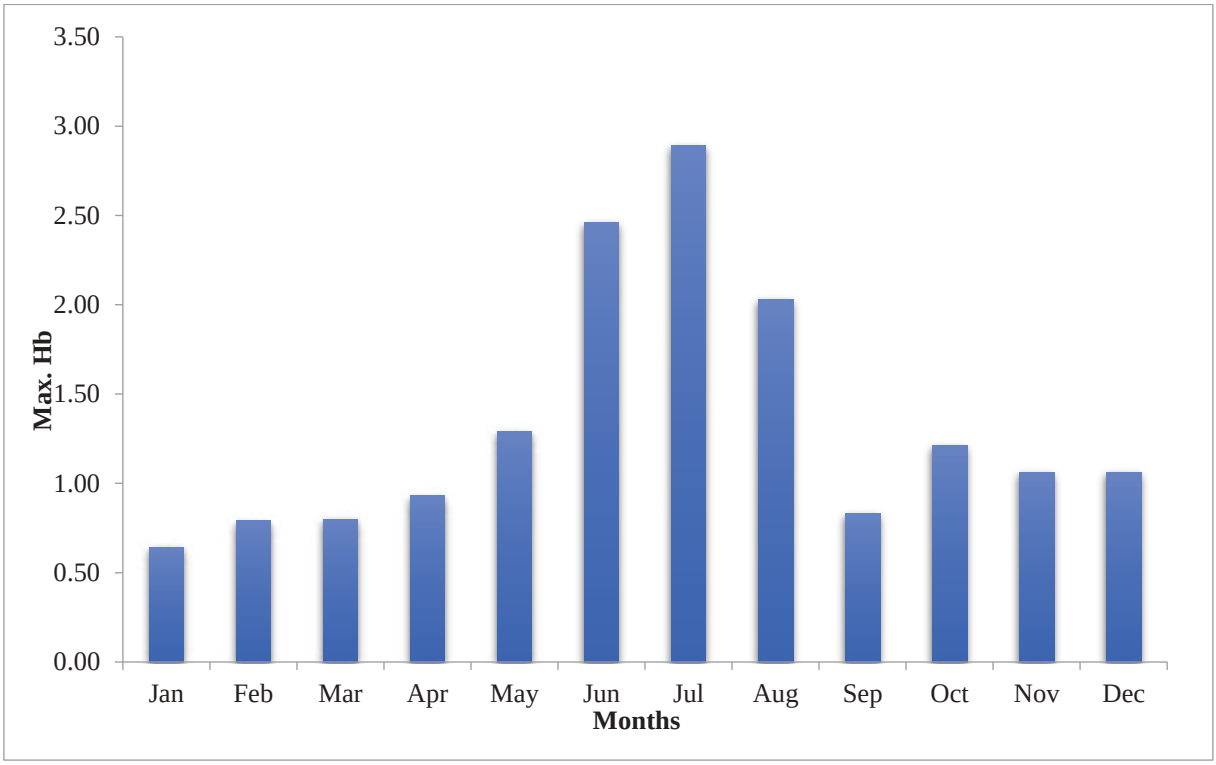


Fig.64a Breaker wave heights of Pallipuram Raktheswari beach

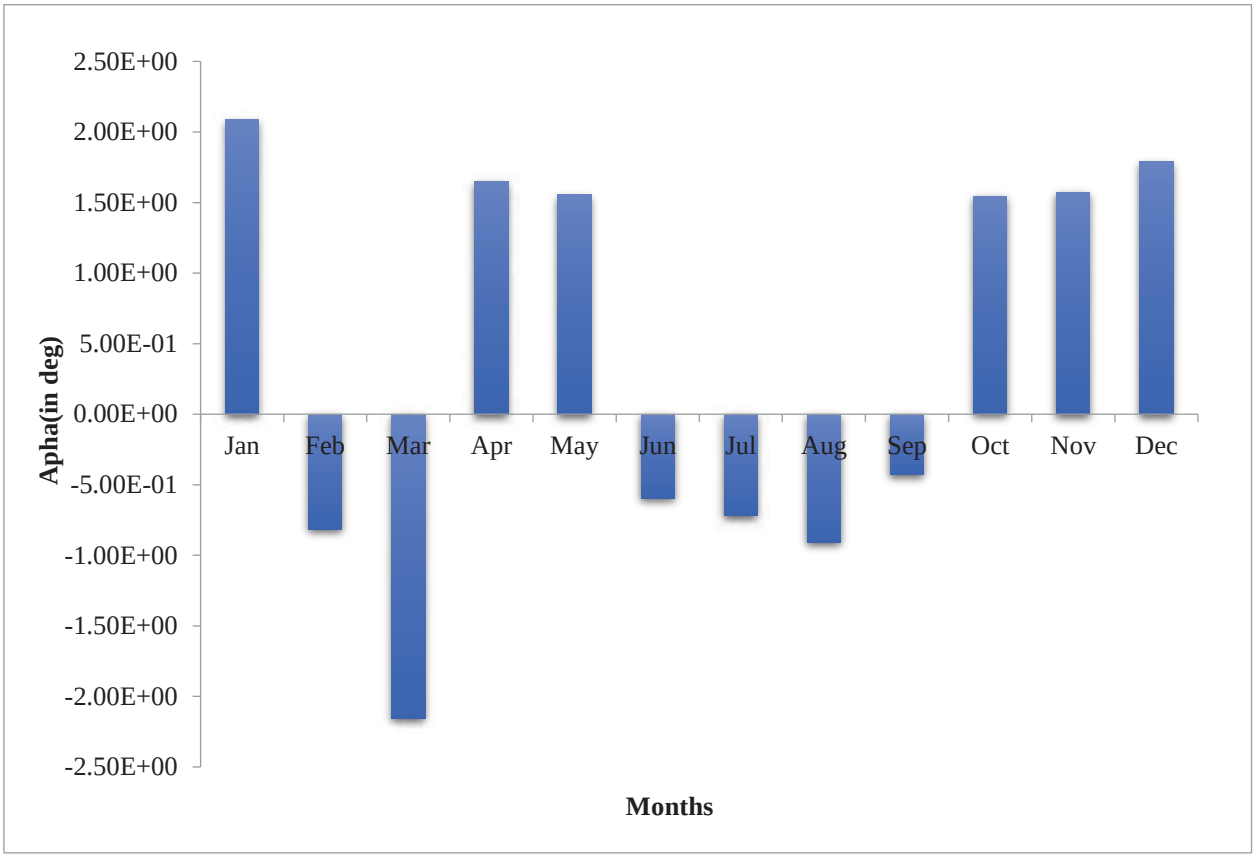


Fig.64bWave breaker angle of Pallipuram Raktheswari beach

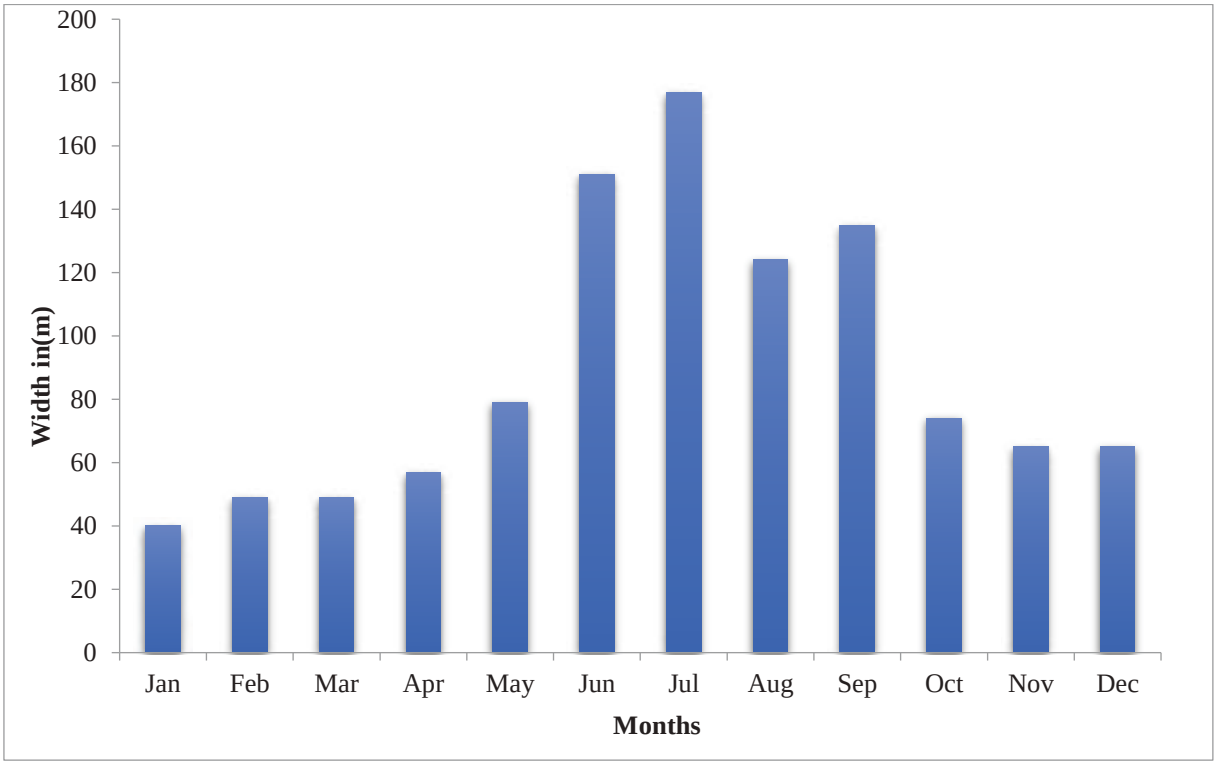


Fig.64c Surf zone width of Pallipuram Raktheswari beach

Table.22 Sediment transport rate of Pallipuram Raktheswari beach

Methods	Rate (m^3/year)
Komar	-132727
CERC	-138243
Distribution	-132943

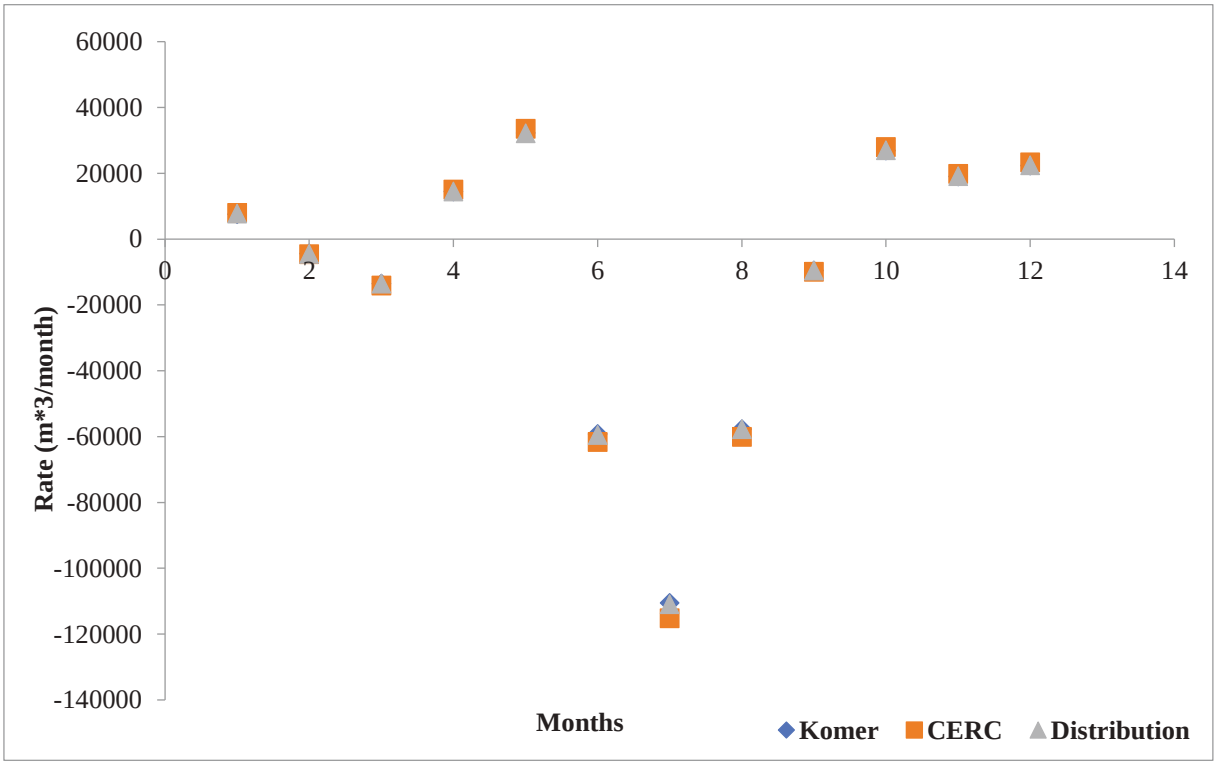


Fig.64d Longshore Sediment transport rate of Pallipuram Raktheswari beach

8.10 Results on the Littoral Drift Estimate Cherai Beach

The monthly distribution of mean breaker wave height for the study area is shown in **Fig.65a**. The results indicate that the mean breaker height varies from about 0.64 m to 2.89 m. The breaker height is observed to be a maximum during the month of July. The monthly distribution of the mean breaker wave angle with respect to shore normal is shown in **Fig.65b**. From the results it is seen that for the study area, the breaker angle with respect to shore normal and longshore current velocity are directed towards North in January , April , May and October to December and towards South in February , march and to June to September**.** The average surf width in which the long shore drift is predominant is further estimated from the breaker

wave height for the given bathymetry and is projected in **Fig.65c** for the different months**.** It shows that the maximum surf width of about 177 m occurs during the month of July.

The average sediment transport rate for the different months is shown in **Fig.65d.** All the three methods have yielded similar order sediment transport rate. The net drift is found to be about -179855 m^3 per annum and directed towards the south as shown in **Table.23.**

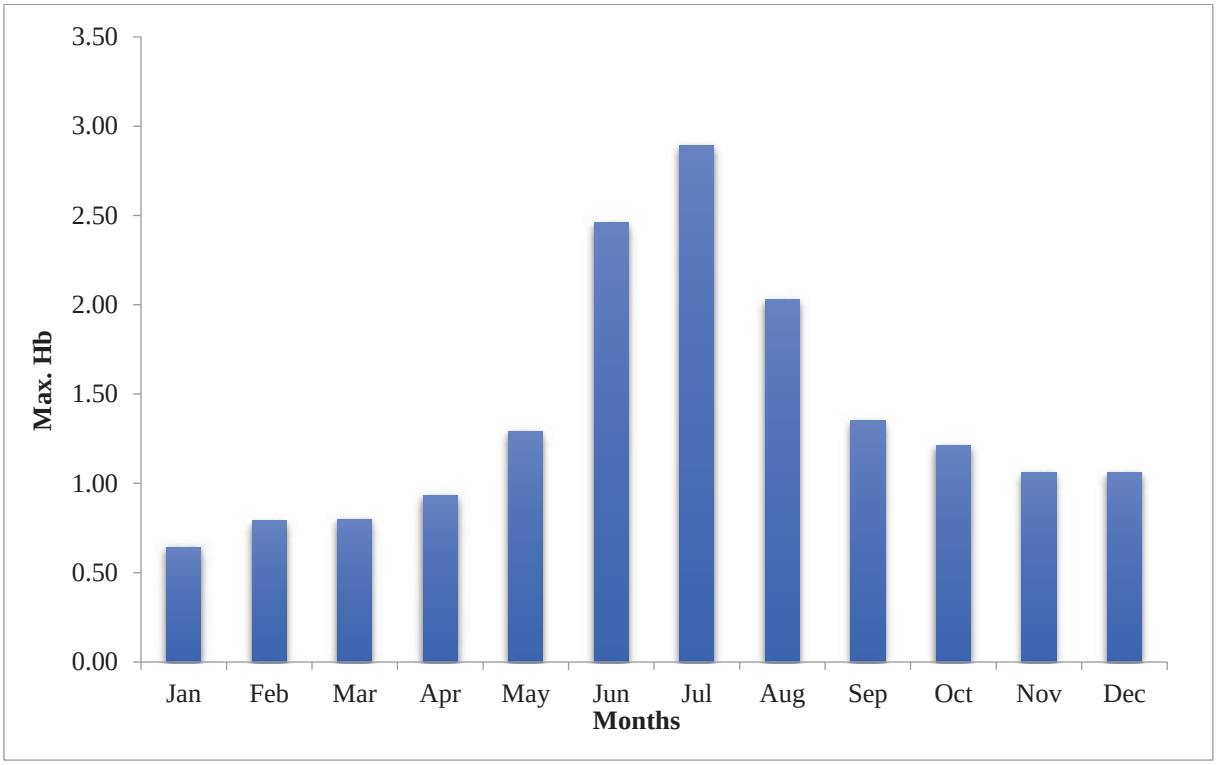


Fig.65a Breaker wave heights of Cherai beach

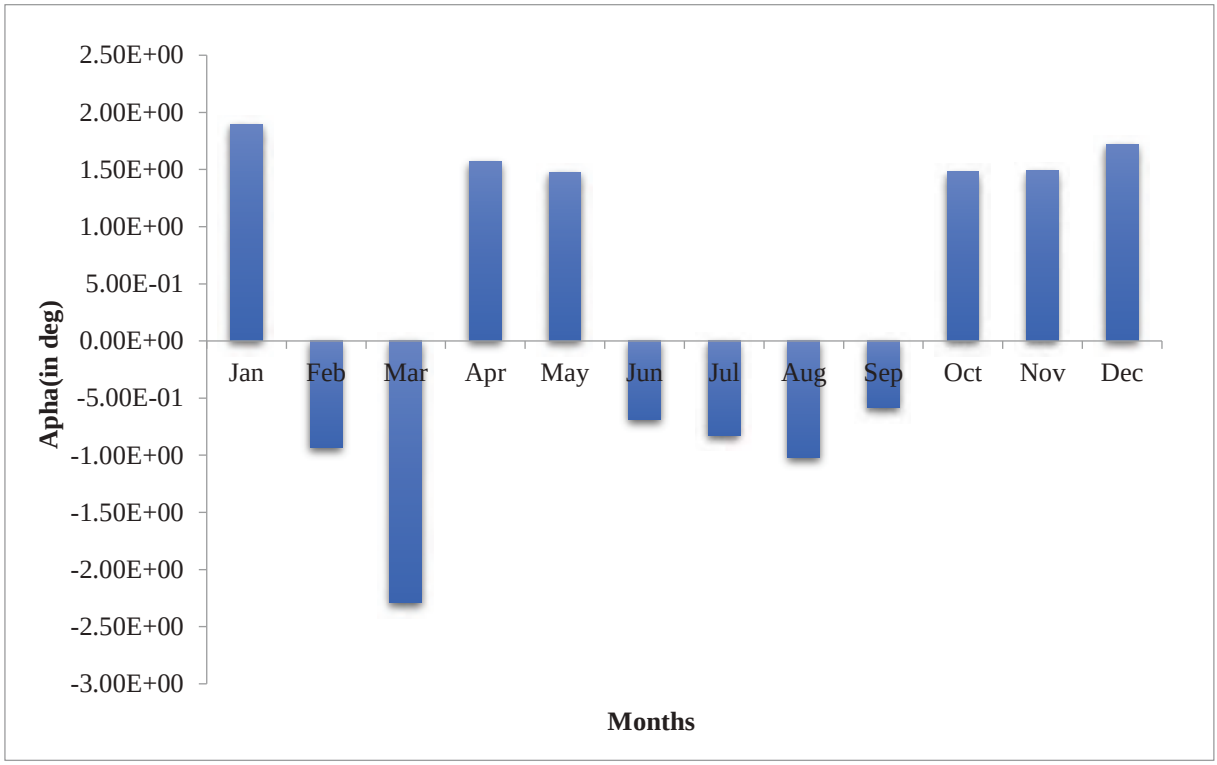


Fig.65b Wave breaker angle of Cherai beach

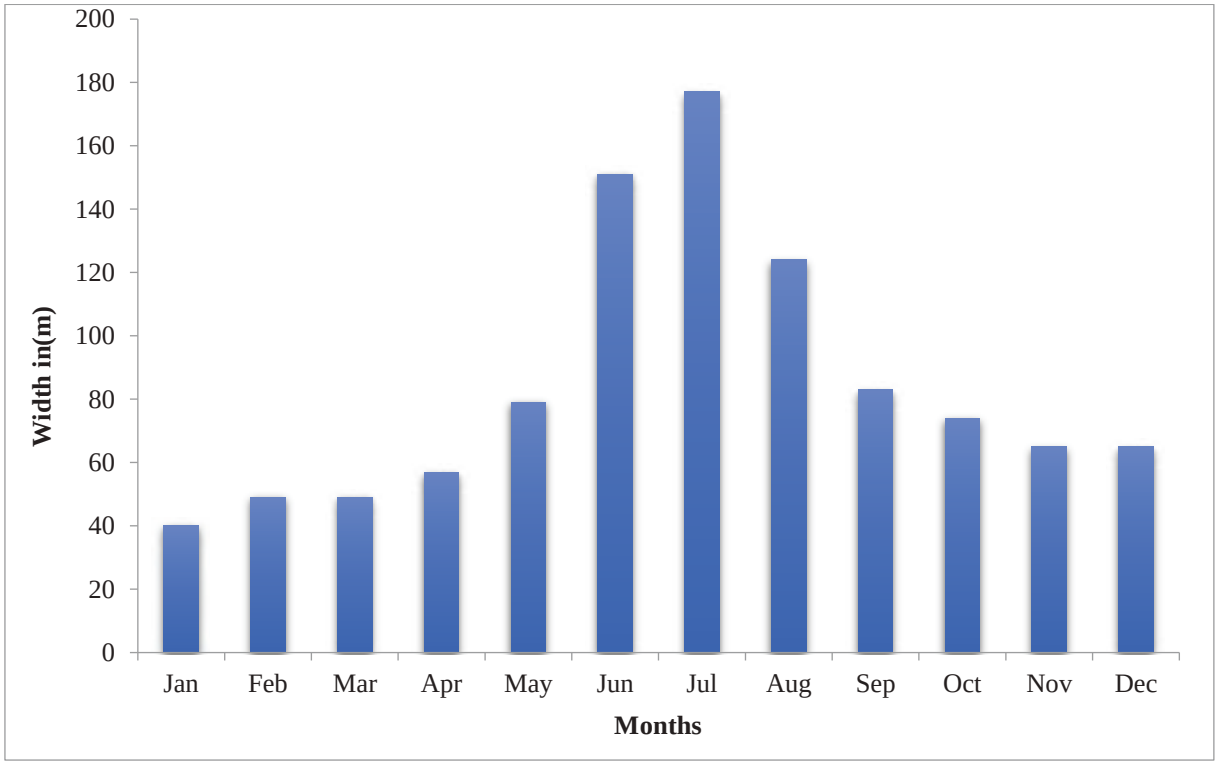


Fig.65c Surf zone width of Cherai beach

Table.23 Sediment transport rate of Cherai beach

Methods	Rate (m^3/year)
Komar	-177282
CERC	-184650
Distribution	-177635

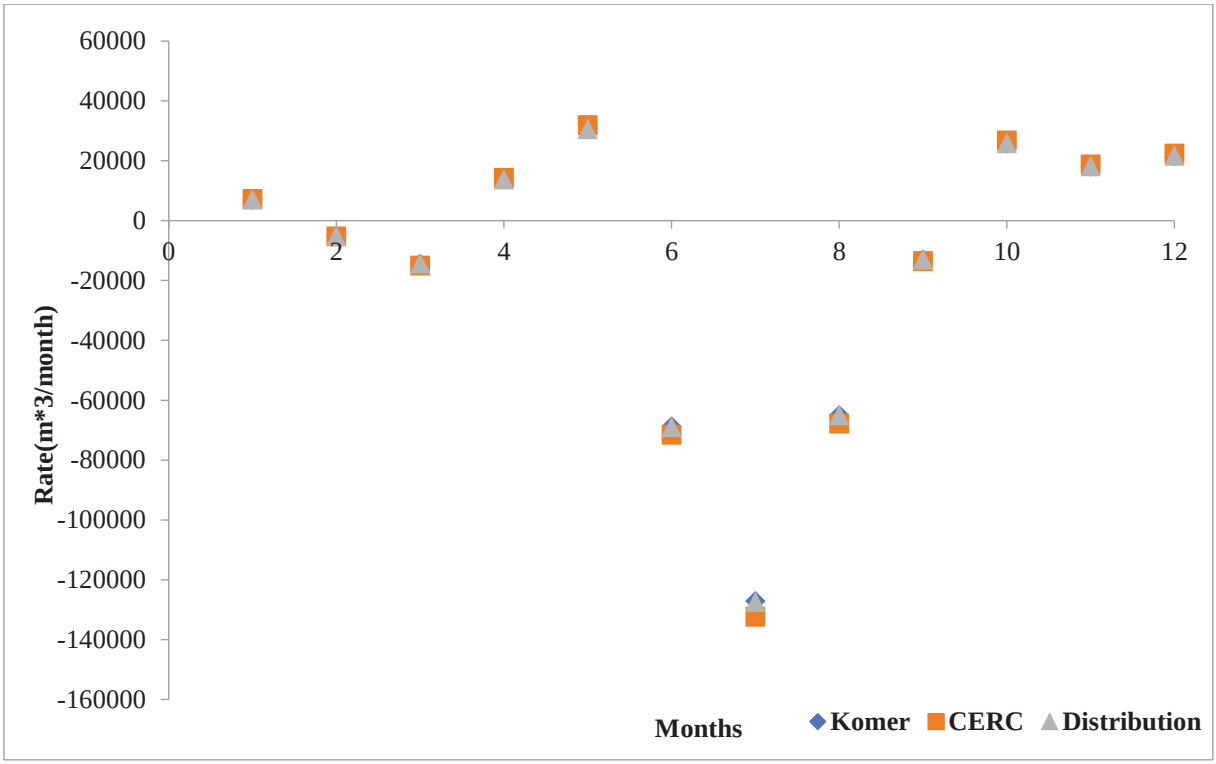


Fig.65d Longshore Sediment transport rate of Cherai beach

8.11 Result Littoral Drift Estimate Arattu Kadavu Beach

The monthly distribution of mean breaker wave height for the study area is shown in **Fig.66a.** The results indicate that the mean breaker height varies from about **0.54 m to 2.74m**. The breaker height is observed to be a maximum during the month of July. The monthly distribution of the mean breaker wave angle with respect to shore normal is shown in **Fig.66b.** From the results it is seen that for the study area, the breaker angle with respect to shore normal and longshore current velocity are directed towards North in January , February , April , May and October to December and towards South in march and to June to September. The average surf width in which the long shore drift is predominant is further estimated from the breaker

wave height for the given bathymetry and is projected in **Fig.66c** for the different months**.** It shows that the maximum surf width of about 168m occurs during the month of July.

The average sediment transport rate for the different months is shown in **Fig.66d.** All the three methods have yielded similar order sediment transport rate. The net drift is found to be about -84496m^3 per annum and directed towards the south as shown in **Table.24.**

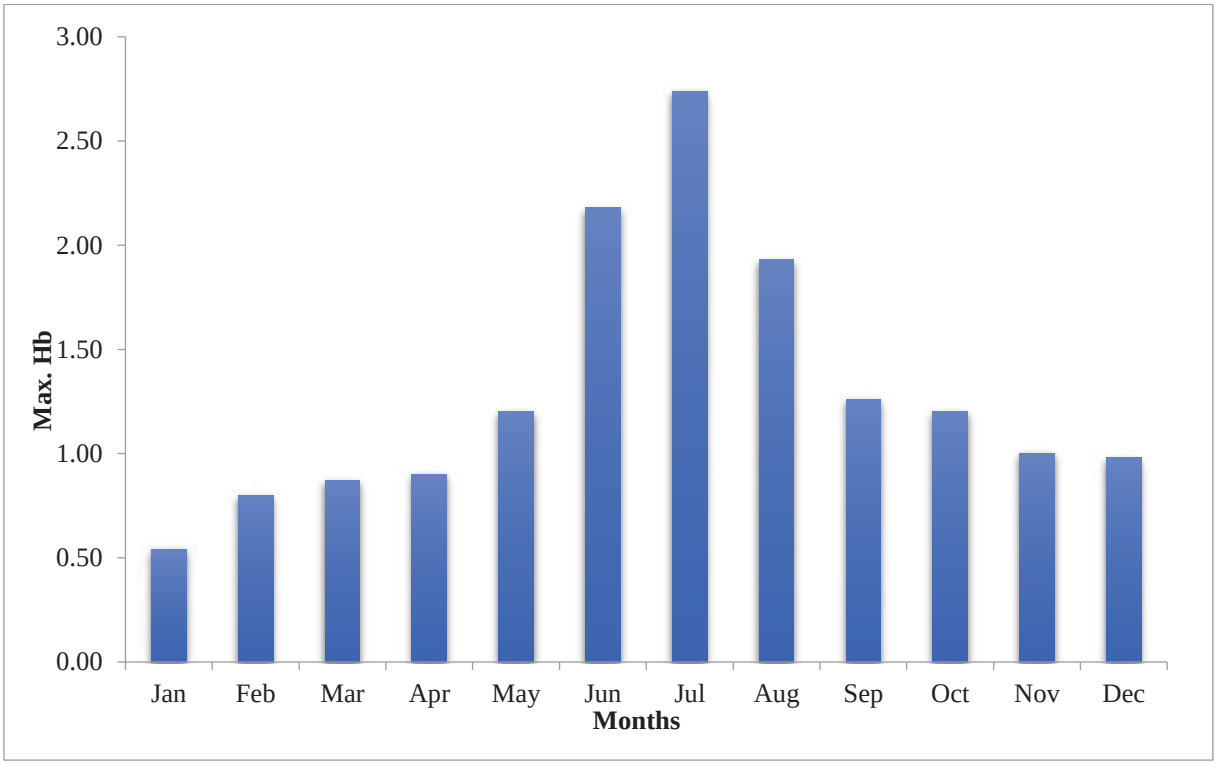


Fig.66a Breaker wave heights of Arattu Kadavu Beach

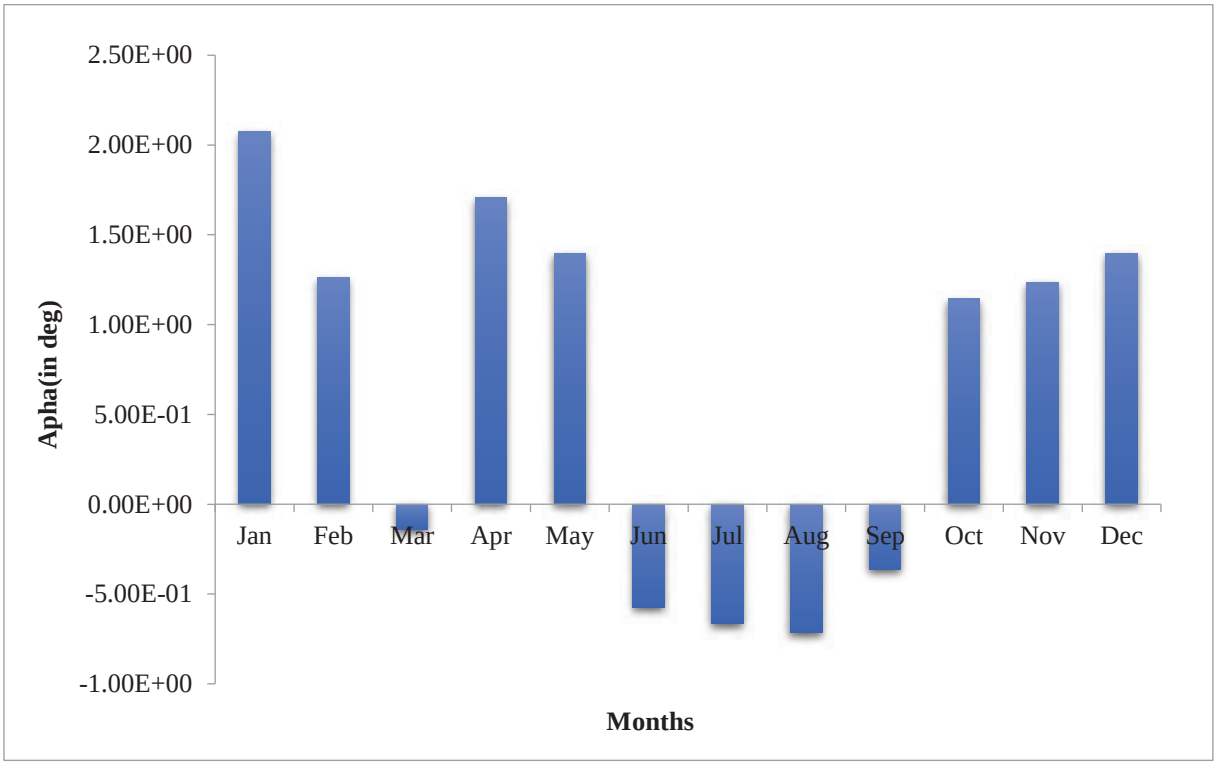


Fig.66b Wave breaker angle of Arattu Kadavu Beach

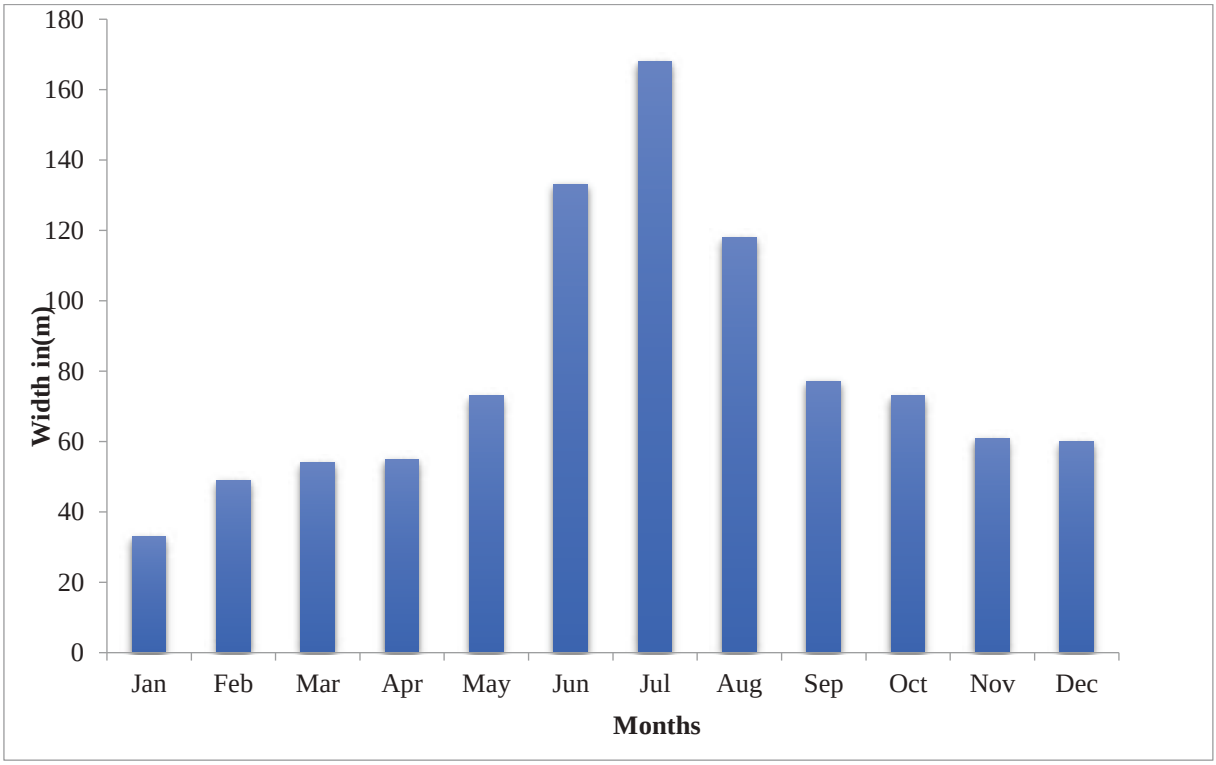


Fig.66c Surf zone width of Arattu Kadavu Beach

Table.24 Sediment transport rate of Arattu Kadavu Beach

Methods	Rate (m^3/year)
Komar	-83164
CERC	-86620
Distribution	-83703

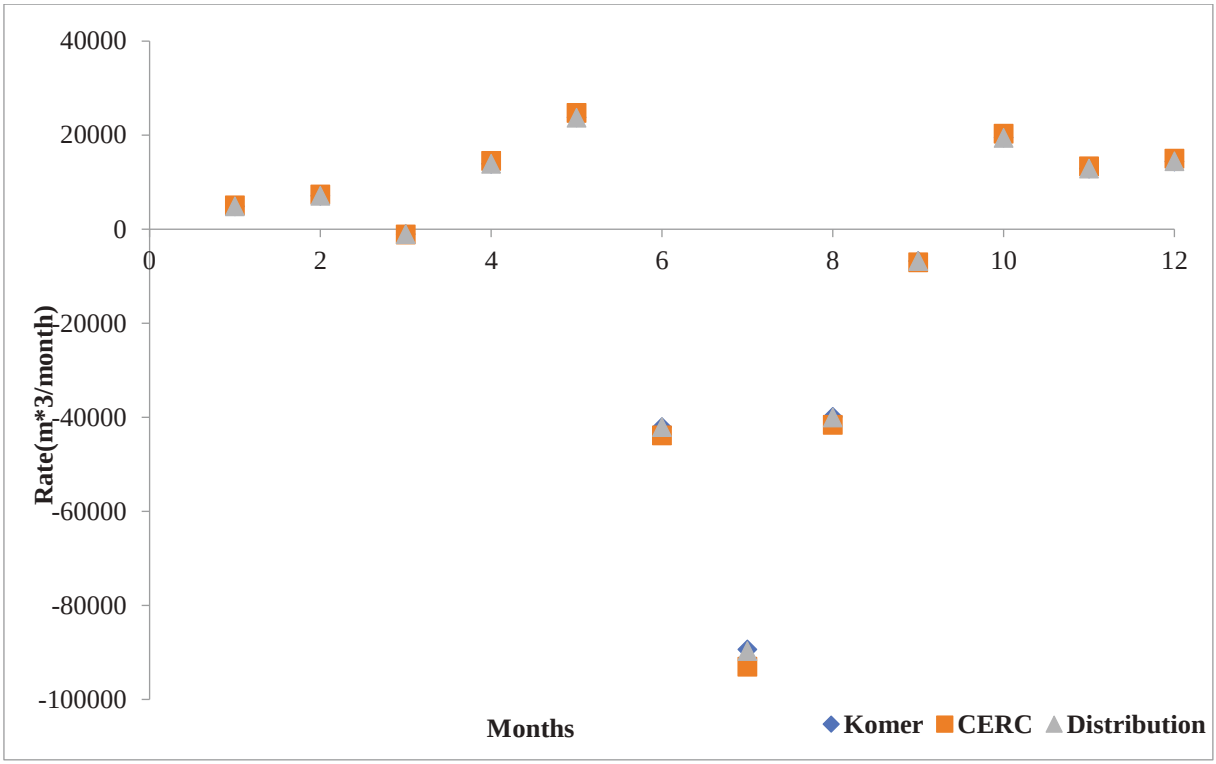


Fig.66d Longshore Sediment transport rate of Arattu Kadavu Beach

8.12. Comparison of sediment transport rates for different stretches

A comparison of a comprehensive study on the littoral drift along the study area is presented in **Table.25**. The breaker wave height for the entire stretch varies between 0.6 to 2.9m with a maximum surf width of about 175m in the month of July. The results shown are self-explanatory.

Table.25. Comparison of littoral drift estimate

Location		Littoral drift characteristics					
Site	Length of the stretch (apx.)	Month of predominant direction of littoral drift		Sediment transport rate (10^6 m^3/yr)			
		Directed towards North	Directed towards south	Komar	CERC	Distribution	Average
Valappu Beach	1.2 km	January, April, May and October to December	February, March and June to September	-0.13	-0.14	-0.13	-0.135
Elamkunnapuzha Beach	1.4 km	January, April, May and October to December	February, March and June to September	-0.128	-0.133	-0.129	-0.13
Njarackal Arattuvazhi Beach	1.3 km	January, April, May and October to December	February, March and June to September	-0.132	-0.138	-0.133	-0.134
Veliyatham Parambu Beach	1.8 km	January, April, May and October to December	February, March and June to September	-0.057	-0.059	-0.057	-0.058
Edavankkadu Grama Panchayat	3.3 km	January, April, May and October to December	February, March and June to September	-0.073	-0.076	-0.073	-0.074
Saidh Mohammed Beach	3.3 km	January, April, May and October to December	February, March and June to September	-0.043	-0.044	-0.043	-0.043
Kuzhippilly	6.8 km	January, April, May and	February, March and June to September	-0.103	-0.107	-0.103	-0.104

		October to December					
Pallipuram Raktheswari beach	6.8 km	January, April, May and October to December	February, March and June to September	-0.133	-0.138	-0.133	-0.135
Cherai beach	6.8 km	January, April, May and October to December	February, March and June to September	-0.177	-0.185	-0.178	-0.180
Arattu Kadavu beach	6.8 km	January, February, April, May and October to December	March and June to September	-0.083	-0.087	-0.084	-0.085

9.0 IMPORTANT COASTAL STRETCHES – FEEDBACK FROM CLIENT

Based on the combined site visit/survey conducted by the Government departments of the Kerala state, the minutes of the meeting was communicated to Prof. Sundar (ref: 4178/G/2018/KSCADC). A preliminary comprehensive plan for the coastal measures along the identified stretches are projected in **Table.26**.

Table.26 Primary plan for coastal protection measures

Locations Identified	Site Name	North Lat/long	South Lat/long	Distance	Existing Structure	Proposed Structures
Fish landing center	Malippuram, Chappakadavu	N 10°1'11.0604" E 76°12'47.4876"	N 10°1'15.8052" E 76°12'46.3104"	0.15 km	Nil	This stretch of **Cell 3** for a distance of about 1.5 km is experiencing erosion upto -10m/yr. The primary requirement is to protect this coast with transitional groyne and if the need arises the central portion of the groyne field covering a base width of 150 – 200 m could be developed as a fish landing harbour. (**Priority 1 and 2**)
Fish landing center	Njarakkal, Near Krishi Vitjaan Kendra	N 10°2'37.78951" E 76°12'23.14688"	N 10°2'38.79388" E 76°12'22.41781"	0.18 km	Sea wall at both sides, with a beach opening at southern end.	A major stretch of this coast is protected with rubble mound seawall and the available gap even for beach landing is hardly 50 m. Hence it may not be cost-effective unless the number of boats operating in this area is large. **(Priority 3)**
Fish landing center	Veliyathamparambu	N 10°2'49.94768" E 76°12'19.41192"	N 10°2'53.8669" E 76°12'17.50619"	0.13 km (beach opening)	Groynes and sea wall at both the sides	The northern groyne to be extended upto a water depth of -3 to -4 m; with a base width of the waterfront of about 250 m another groyne south of the existing southern groyne to be constructed. This will accommodate about 100-150 boats **(Priority 1)**. Since the erosion rate is very less (-0.25m/yr) this stretch is ideal for a fishing harbour
Fish landing center	Puthenkadappuram	N 10°3'53.60576" E 76°11'55.69982"	N 10°3'57.80577" E 76°11'54.10752"	0.14 km	Series of 6 groins at north	This stretch experiences an erosion rate of -0.5 m/yr. A fish landing facility can be provided by having a pair of groynes

					and sea wall at southern	with the northern groyne being longer than the southern. **(Priority 2)**
Fish landing center	Aniyal	N 10°4'36.05833" E 76°11'44.34713"	N 10°4'39.22827" E 76°11'44.05199"	0.06 km	At southern end there is a groyne of 50m length at a distance of 130m from sea wall	This stretch of the coast is accreting at an average rate of 2.5 m/yr and owing to the reduced access to the roadways network construction of landing facilities may not be feasible. **(Priority 3)**
Fish landing center	Pazhangadu-Puthenkadappuram	N 10°4'58.64154" E 76°11'39.52792"	N 10°5'1.18003" E 76°11'38.20931"	0.1 km (beach opening)	Sea wall at both ends	From the ending of seawall on the north a base width of 150 m could be considered for the development of a mini fish landing centre. The constructions of these 2 arms of the proposed harbour will not be affecting the adjoining shoreline, as it is protected by a seawall. **(Priority 2)**
Fish landing center	Saidh Mohammed beach-2	N 10°5'51.75364" E 76°11'23.263"	N 10°5'55.86458" E 76°11'22.20465"	0.13 km	A series of 6 located south of the beach stretch	Adopt a base width of 150m from the existing southern end. Provision of a pair of curved arm breakwaters upto -2 m water depth to handle small fishing crafts. **(Priority 2)**
Fish landing center	Kuzhuppilly	N 10°6'32.688" E 76°11'14.5356"	N 10°6'36.2916" E 76°11'13.9812"	0.11 km	Nil	Included in the stretch of the coast under item no. 13 of this table.
Fish landing center	Ayyambilly	N 10°7'5.7576" E 76°11'6.4176"	N 10°7'10.7328" E 76°11'5.2836"	0.16 km	Nil	
Fish landing center	Arattukadavu	N 10°8'57.40798" E 76°10'32.9444"	N 10°8'59.5872" E 76°10'32.15672"	0.07 km (beach opening)	Both end covered with sea wall	A bay formation is seen in between two existing seawalls which could handle the ongoing erosion, a pair of curved groynes locally termed as pulimuttam

						could be adopted to form a fish landing facility. The groynes can extend up to a water depth of -2 m. (**Priority 3)**
Tourism destination	Puthuvype	N 9°59'51.9019" E 76°13'5.9023"	N 9°59'58.5019" E 76°13'4.8015"	0.21 km	Nil	The shoreline change analysis projects an average rate of 2.5 m/yr of accretion. No immediate action is required. **(Priority 3).** Further, the proposal with IOCL is available which if implemented will resolve the problem
Tourism destination	Valappu	N 10°0'20.37899" E 76°13'0.49256"	N 10°0'45.35078" E 76°12'54.41616"	0.79 km	Nil	Submerged reef geo-tubes (detached) **OR** transitional T-groynes. Rate of erosion -0.25 m/yr. **(Priority 2)**
Tourism destination	Saidh Mohammed beach-2	N 10°5'55.86458" E 76°11'22.20465"	N 10°8'28.068" E 76°10'42.78"	4.83 km		This stretch of about 4.5 km will be protected with submerged geo-tubes (detached) or T groyne field **(Priority 1)**. Zaid Mhd beach 2: -1 to +1 m/yr. Kuzhuppilly beach: -1 m/yr. Raktheswari beach: -2 m/yr. Cherai beach: -2 m/yr.
	Kuzhuppilly Beach					
	Raktheswari Beach					
	Cherai Beach					

10.0 PROPOSED SHORE PROTECTION WORKS

For the sites identified as Priority 1 and 2 in **Table 26**, detailed shore protection works are presented in this section. The layouts were finalized based on the results arrived from numerical model of CG wave and shoreline evolution. A total of 5 fishing landing centres and two important tourist locations were identified. Conventional shore connected transitional groynes or a pair of groynes were employed for effective shore protection and safe fish landing; the use of sustainable and environment friendly geo-synthetic materials are encouraged and adopted for the offshore submerged breakwaters as well as the shore connected low crested structures. Submerged coastal structures are widely perceived to be capable of providing beach protection, without the adverse impacts (including loss of beach amenity and aesthetic considerations) often associated with conventional hard engineering structures. When used for beach stabilization the function of offshore submerged structures is to reduce wave energy in their lee and thereby reducing the sediment carrying capacity of the waves to the shoreward. They can be designed to reduce or prevent the erosion of an existing beach or a beach fill, or to encourage natural sediment accumulation to form a new beach. The structures reduce the incoming wave energy across the structure by triggering wave breaking at and on the structure, by partially reflecting the waves and by dissipation. These structures have significant influence on the recreational conditions for beach users. Some influences are regarded as positive, while others are considered as negative. The influence is either direct due to the physical presence of the structure in the nearshore zone, or indirect due to the consequent effects on the local hydro-morphodynamics. For the detached offshore structures, the pressure gradients produced by the setup forced by the waves breaking over submerged barriers between the protected area and the sea (Calabrese et al., 2008; Vicinanza et al., 2009) generate a seaward-flowing current, known as a "***rip current***" through the gaps between two contiguous breakwaters, as shown by Brocchini et al. (2004). Intense sediment transport toward the sea is generated by such currents, thus causing a significant sediment loss; also dangerous for swimmers' safety. Significant efforts have been undertaken in the last decade to investigate both the hydrodynamics (Kramer et al., 2005; Kriezi and Karambas, 2010; Losada et al., 2005) and the morphodynamics (Karambas, 2012; Zyserman et al., 2005) induced around low-crested structures. Therefore the spacing between these detached offshore structures needs to be planned with utmost attention to detail.

10.1 Valappu Beach

Valappu Beach is a popular tourist location along the Ernakulam coast, situated in the vicinity of BPCL and IOCL oil refiner facilities. Based on the satellite imagery studies conducted this site has been observed to undergo moderate erosion rates. IIT Madras has already proposed a few costal protections measures adjacent to the BPCL and IOCL facilities; in addition to the aforementioned measures, commissioning a singular 820 m long section of a submerged geo-tube parallel to the shoreline is proposed, which would effectively function as an offshore submerged breakwater. Morphodynamics induced around submerged breakwaters is strongly influenced by its positioning. The bed variations were shown to increase when the structures are progressively located offshore; when dissipative breaking mechanisms occur, a decreasing inshore erosion is accompanied by an equally fast decrease of offshore erosion. Analysis of the vorticity fields show that breakwaters placed far from the shoreline induce an evolution of the vortices generated by breaking waves rather different from the one due to breakwaters placed closer to the shoreline (Postacchini et al., 2016). This offshore submerged geo-tube is proposed to erected at -5m water depth, 1600 m away from the shoreline. **Plate 1** details the layout of the proposed protection measure. The adopted layout dimensions satisfy the conditions *(L_s/X > 0.5, i.e., ratio of the breakwater length to its distance from the shore is 0.53 which is favourable for salient formations)* put forth by Dally and Pope (1986) Chasten et al., (1993) and Seiji et.al., (1987) for the formation of salient for an offshore emerged structure. According to Lorenzoni et al., (2012) submerged configurations show larger shoreline retreats than the emerged ones at the same position and for the same wave attack conditions. Although proper planning and execution of submerged structures will yield favourable results as seen in Yucan, Mexico (Alvarez et al., 2007); Teluk Kalong, Kemaman, Terengganu Malaysia (Lee and Douglas, 2011), etc.

10.2 Malipuram

This coast is identified to experience high erosion at the rate of about -10m/yr through remote sensing studies. Although this site has been identified as a fish landing centre, there is an urgent need to protect the eroding coastline. Therefore, a series of six transitional groynes are proposed to be constructed across a stretch of about 1 km. Four number of T groynes, two on either ends and two number of straight groynes in the central section are proposed. The straight groynes can be further extended to form a fishing harbour if necessary. A base landing width of 250 m is provided to accommodate sufficient number of fishing vessels; these groynes extend upto a maximum water depth of about -2 m. The longest groyne in this series is about 120 m long and the shortest groyne is about 50 m long as seen in **Plate 2**.

10.3 Veliyathamparambu

This stretch of the coastline identified as a fishing landing centre is already protected with a seawall structure to its south and a single groyne exists in the northern side. The rate of erosion across this stretch is inferred to be less based on the satellite imagery studies, since it is already protected. Although a pair of inclined groynes as seen in **Plate 3** are proposed to be constructed in order to effectively serve as a fish landing facility. These groynes are about 180 m long extending to water depths upto 3 m.

10.4 Puthenkadappuram

This stretch of the coastline identified as a fishing landing centre is already protected with a seawall structure to its south and groyne field on the northern side. A proposal to construct a pair of groynes as seen in **Plate 4** is made, which includes the extension of an existing groyne on the northern side. These groynes are about 130 m long and extend to a water depth of up to 3.5 m, with a base width of about 200 m.

10.5 Pazhangadu

This stretch of the coastline is identified as a fishing landing centre and it is already protected with seawall sections on either side. A pair of groynes are proposed to be constructed as shown in **Plate 5**. These groynes are about 180 m long and extend to a water depth of 3.4 m with a base width of about 200 m.

10.6 Saidh Mohammed beach

This stretch of the coastline is identified as a fishing landing centre and it is already protected with seawall and groynes. A proposal is made to extend the existing groynes for about 160 m in length (upto -3 m water depth) and construct a pair of groynes to form a fish landing centre with a base width of about 150 m as seen in **Plate 6**.

10.7 Saidh Mohammed beach -2 to Cherai Beach

This stretch is an important tourist destination spanning a length of about 4 km. It covers four important tourist beaches namely the Saidh Mohammed beach, Kuzhuppilly Beach, Raktheswari, and Cherai. The erosion rate across these stretches is about -2m/yr and hence suitable protection measures for these sites are proposed to retrieve the lost beaches. Two different options are proposed for shore protection and the said works are preferred to be carried out in two phases. For ***option 1*** initially, a series of short straight transitional groynes (the length of these short groynes vary between 20 m and 70 m) are proposed to be constructed as **phase 1**. The longer groynes (i.e.) of length 60 m and above in the said layout is designed to be sustainable by adopting geo-containers for core layer and geo-bags for toe protection, which

are submerged at HWL (High Water Line). The details of these sustainable groynes are briefed in the design section. These groynes will immediately arrest the longshore sediments and result in beach width growth, the additional beach width gained can be utilized for establishing recreational activities. After observing the beach response to the structures constructed in phase 1, construction of submerged geo-tube units at the head of the longer groynes are proposed to be constructed as **phase 2**. The details of the proposed option 1 is given in **Plate 7**.

For ***option 2***, the previously proposed **phase 1** is retained and in **phase 2**, after the assessment of the behaviour of shoreline, 3 detached offshore submerged geo-tube sections is proposed to be commissioned. The details of the proposed option 2 is given in **Plate 8**. The primary function of these submerged structures is to promote pre-mature breaking of ocean waves and thereby reducing the wave impact on the coast which in-turn diminishes the active erosion of the coast. The proposed length of the groynes does not exceed 70 m which is less than the surf zone width prevalent along the coast. The adopted layout dimensions satisfy the conditions *($L_s/X > 0.5$, i.e., ratio of the breakwater length to its distance from the shore is 0.6 which is favourable for salient formations; $0.8 < L_g/X < 1.5$ possible erosion opposite to gap, i.e., ratio of the breakwater gap width to its distance from the shore is 1.1, the possibility of erosion is evaded owing to the presence of short groynes)* put forth by Dally and Pope (1986) Chasten et al., (1993) and Seiji et.al., (1987) for the formation of salient of an offshore emerged structure.

11.0 NUMERICAL MODELLING FOR SHORELINE EVOLUTION

11.1 General

Structures in the nearshore environment are built for different purposes, which may be for the formation of artificial harbors, shore protection measures, seawater intake systems, disposal of effluent, etc. There are several configurations of such structures with respect to the shoreline, among which, structures normal to the shore are most common. The construction of a shore-connected structure often leads to changes in the shoreline. This warrants a study on the shoreline due to the presence of the shore-connected structures. Such a study is very much essential in the planning stage; so as to assess the impact of shore connected structures on the adjacent shoreline.

Numerical models offer the capability to study the effect of the wave characteristics, structure dimensions and other associated parameters in providing reasonable estimates of the shoreline response. As the ocean waves approach the nearshore it undergoes transformations like

shoaling, refraction, diffraction and breaking. The phenomena of wave breaking throw sediments to the surface due to the turbulence generated. The sediments in suspension are then driven by the wave-induced currents. Since the direction of waves in the nearshore is oblique, the currents induced by them have two components. One along the shore called the longshore current is mainly responsible for the longshore sediment transport, which plays an important role in the shoreline changes especially due to the shore connected structures. The other component is in the direction normal to the shore, in which case, the mode of sediment transport is called onshore-offshore sediment transport. When a structure normal to the shoreline is constructed, it will intercept the free passage of longshore sediment transport, which results in an imbalance in the quantity of sediment on the nearshore, especially near the structure. This leads to accretion on the up-drift side and erosion on the downdrift side of the structure.

11.2 Methodology

Kraus and Harikai (1983) proposed a numerical scheme to solve the one-line model using Crank Nicholson implicit finite difference method. The non-dimensional equation of shoreline is given below

$$y^*_{n,t^*+1} = B\left\{Q^*_{n,t^*+1} - Q^*_{n+1,t^*+1}\right\} + C_n$$

$$where\, B = \frac{\delta t^*}{2\times\delta x^*}\, and\, C_n = B\left\{Q^*_{n,t^*} - Q^*_{n+1,t^*} + 2\delta x^* q^*_{n,t^*}\right\} + y^*_{n,t^*}$$

The non-dimensional shoreline is divided into ‘n’ grid points at equal non-dimensional interval, δx^*. Then shoreline changes over a non-dimensional time, δt^* is calculated using Crank-Nicholson finite difference scheme. The schematic diagram for finite difference scheme is shown in **Fig. 67.**

In this method, Q^* at the time interval (t^* +1) is expressed in terms of the shoreline co-ordinate of y*, first isolating the term involving α_{sp} (angle of shoreline normal to x-axis) using trigonometric identities. One of the term involving α_{sp} is then expressed as first order quantities in y* at time step (t*+1).

$$Q^* = K_D^2 \cos(\alpha_o)\sin(\alpha_b)$$

Where, $\alpha_o = \alpha - \alpha_{sp}$ and α is wave direction with respect to x-axis. The definition sketch showing the angles is shown in **Fig. 68.**

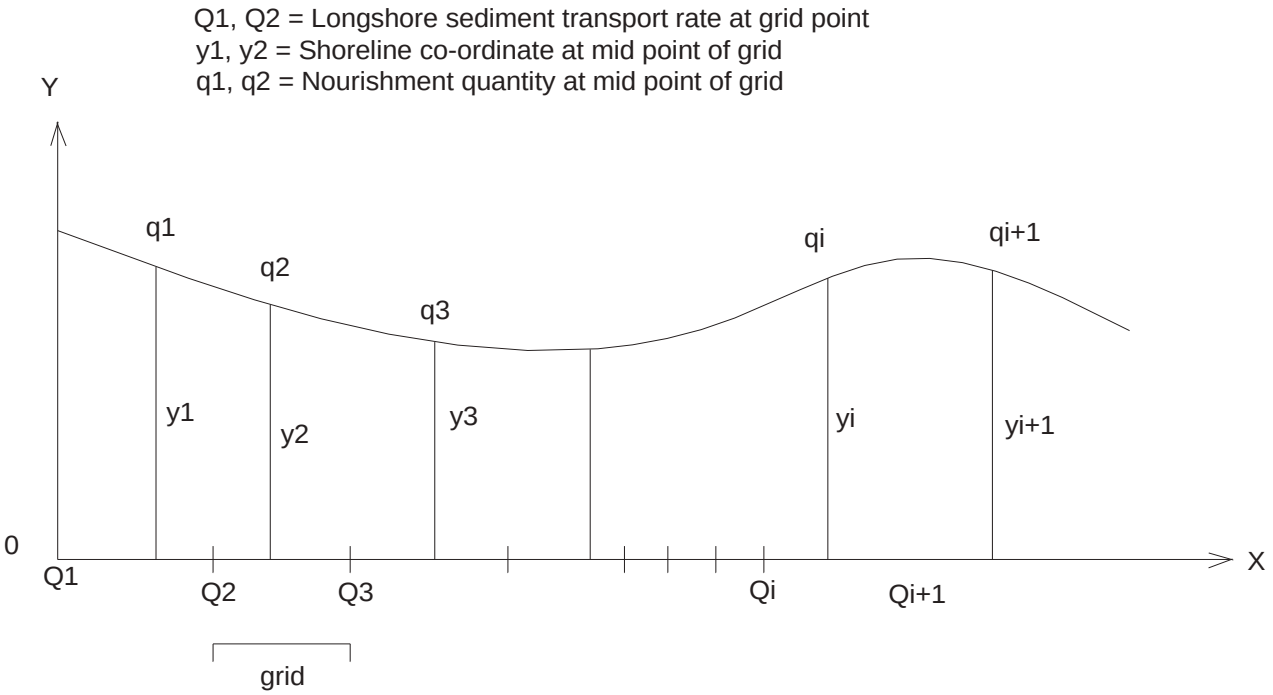


Fig. 67. Schematic diagram for finite difference scheme

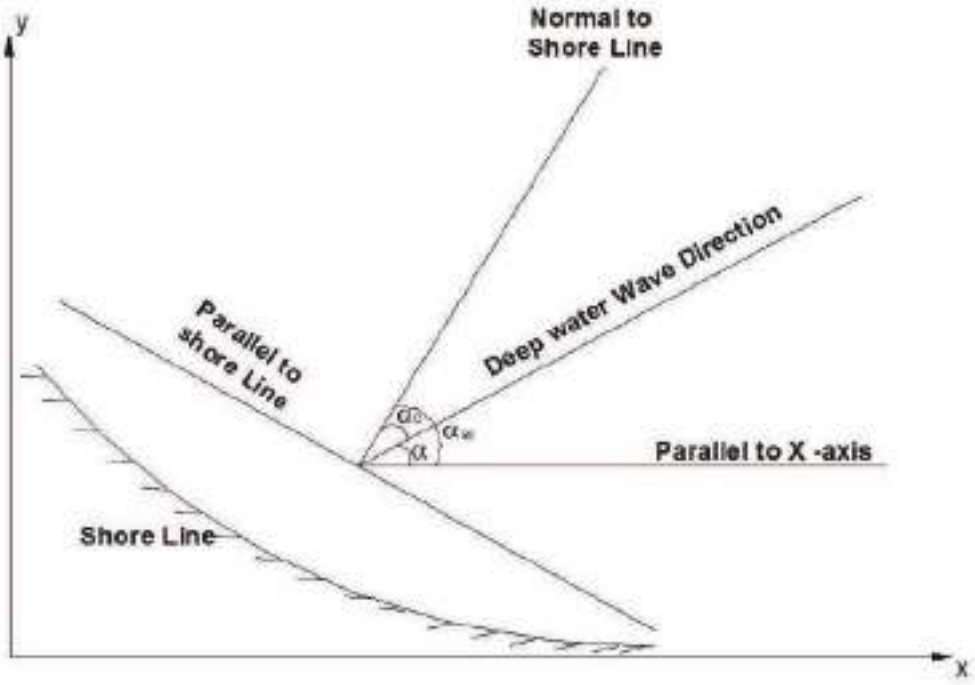


Fig. 68. Definition sketch of angles considered

The elliptical form of mild slope equation, which deals with combined refraction-diffraction,

$$Q^* \rightleftarrows= \rightleftarrows K_D^2 \rightleftarrows cos \rightleftarrows (\alpha - \alpha_{sp}) sin \rightleftarrows (\alpha_b) \quad (8)$$

$$Q^* \rightleftarrows= \rightleftarrows K_D^2 \rightleftarrows sin \rightleftarrows (\alpha_b) \rightleftarrows \{cos \rightleftarrows (\alpha) sin(\alpha_{sp}) \rightleftarrows cot(\alpha_{sp}) \rightleftarrows + \rightleftarrows sin \rightleftarrows (\alpha) \rightleftarrows sin \rightleftarrows (\alpha_{sp})\} \quad (9)$$

$$Q^* \rightleftarrows= \rightleftarrows E_n \rightleftarrows \{y_{n-1,t^*+1} - y^*_{n,t^*+1}\} + F_n \quad (10)$$

Where $E_n = K_D^2 \{\cos(\alpha)\sin(\alpha_{sp,t^*})\sin(\alpha_{b,t^*})\}/\delta x^*$ *and* $F_n = K_D^2 \{\sin(\alpha_{sp,t^*})\sin(\alpha_{b,t^*})\}$

By substituting above equations, give the final equation as given below

$$BE_n\, Q^*_{n-1,t^*+1} - (1+2BE_n) Q^*_{n,t^*+1} + BE_n\, Q^*_{n+1,t^*+1} = E_n [C_n - C_{n-1}] - F_n$$

The above equations represent a set of (N-1) linear equation for (N-1) unknowns. The end values are specified as boundary conditions, that is, $Q^*_1 = 0$ and $Q^*_{N+1} = Q^*_N$. The above equation results into a tridiagonal form which is solved for Q^*. This process is repeated for the entire duration and non-dimensional quantity is converted into real quantities using the corresponding scale factors. The program has been validated with published results.

11.3 Input and Output

The numerical model to predict the shoreline evolution due to the shore-connected structures has been used to predict the shoreline changes due to the proposed groins. The wave characteristics are given as the input to the numerical model. The length of the groins, water depth at the end of the groins, and the present status of the shore are to be given as the input to the numerical model.

The numerical model was executed for the most frequently occurring wave characteristics for the different months as stated earlier**.** The result of the predicted shoreline variations for Malippuram, Veliyathamparambu, Puthenkadappuram, Pazhangadu, Saidh Mohammed beach and phase 1 of Saidh Mohammed beach 2 to Cherai beach over years is projected in **Figs. 69 to 74** respectively. The shoreline prediction has been made at the end of 1 year, 5years, 10years, 15 years, 20 years, and 25 years after the construction of the groins and has been presented by superimposing the shoreline patterns.

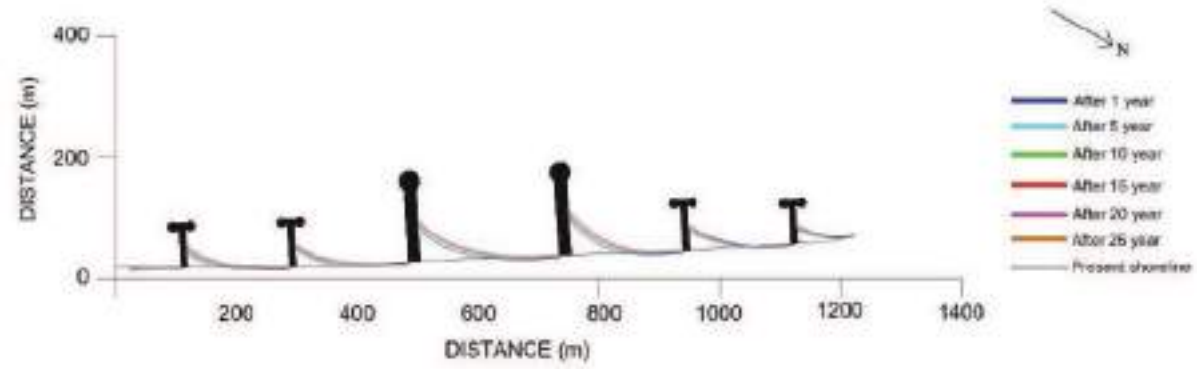


Fig. 69 Shoreline analysis for Malippuram

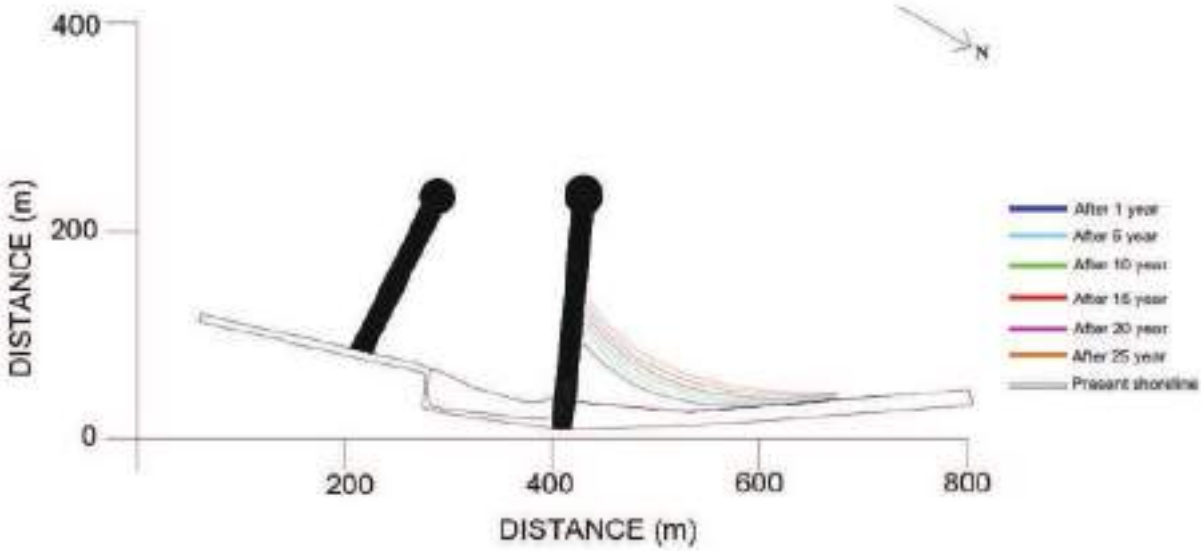


Fig. 70 Shoreline analysis for Veliyathamparambu

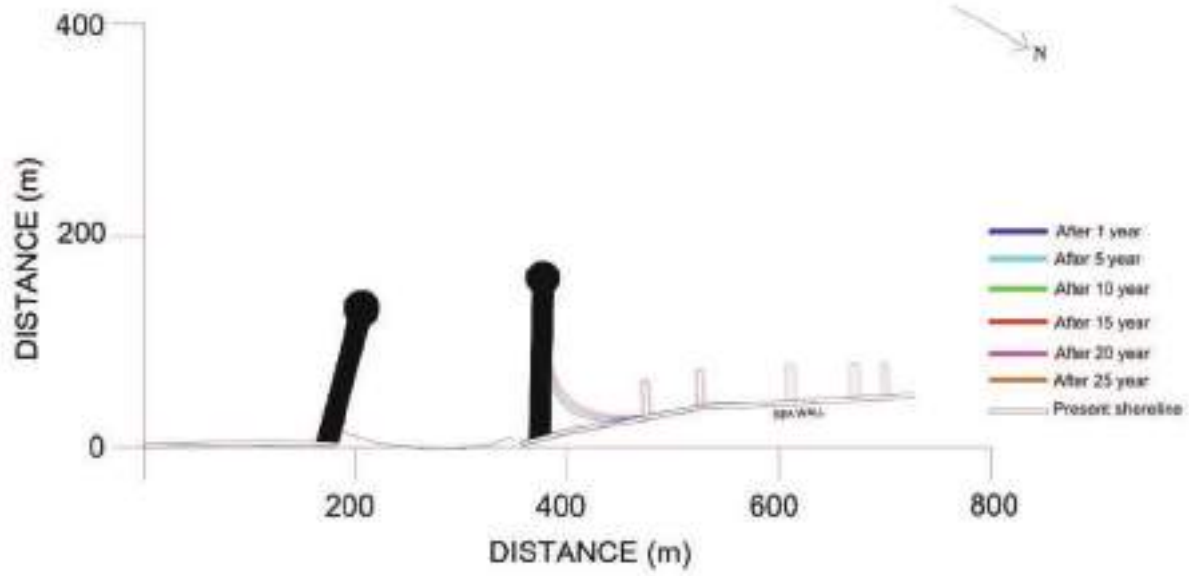


Fig. 71 Shoreline analysis for Puthenkadappuram

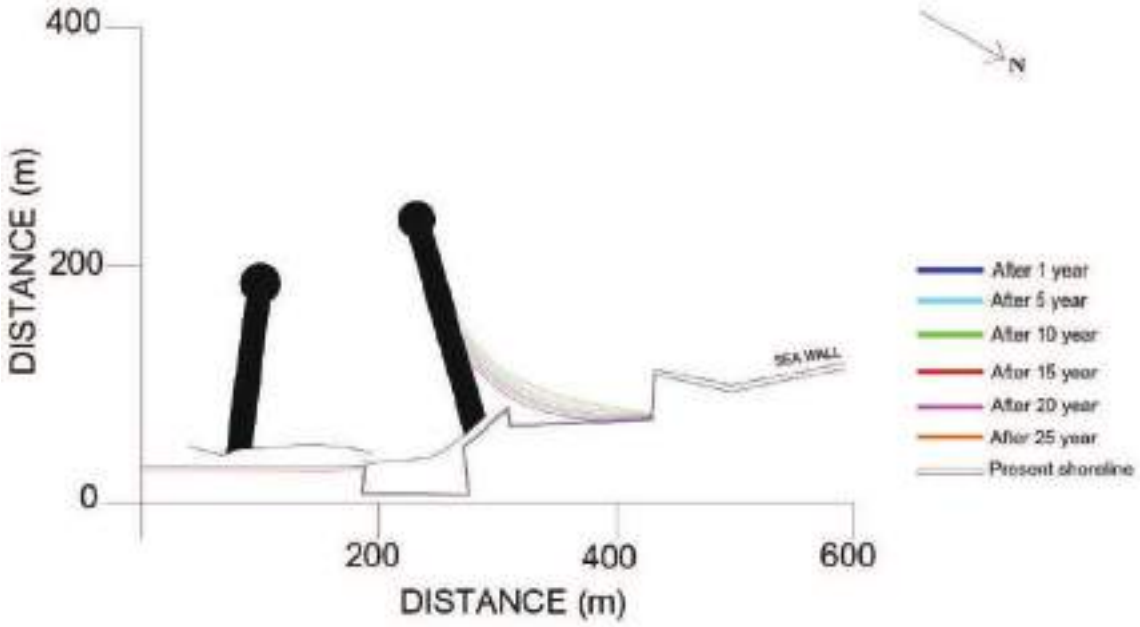


Fig. 72 Shoreline analysis for Pazhangadu

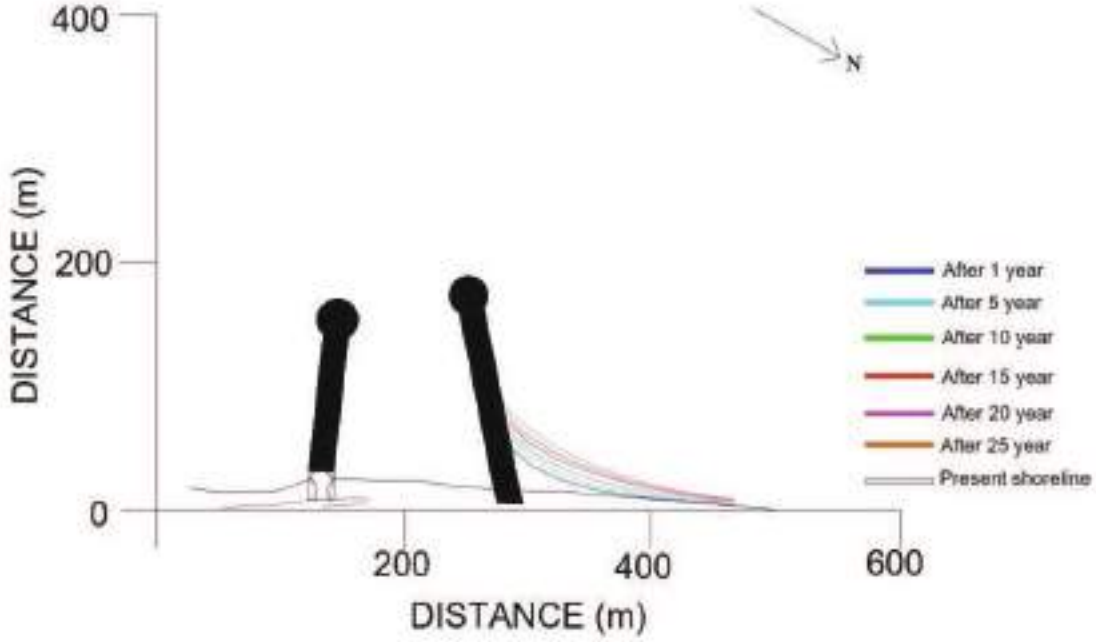


Fig. 73 Shoreline analysis for Saidh Mohammed beach

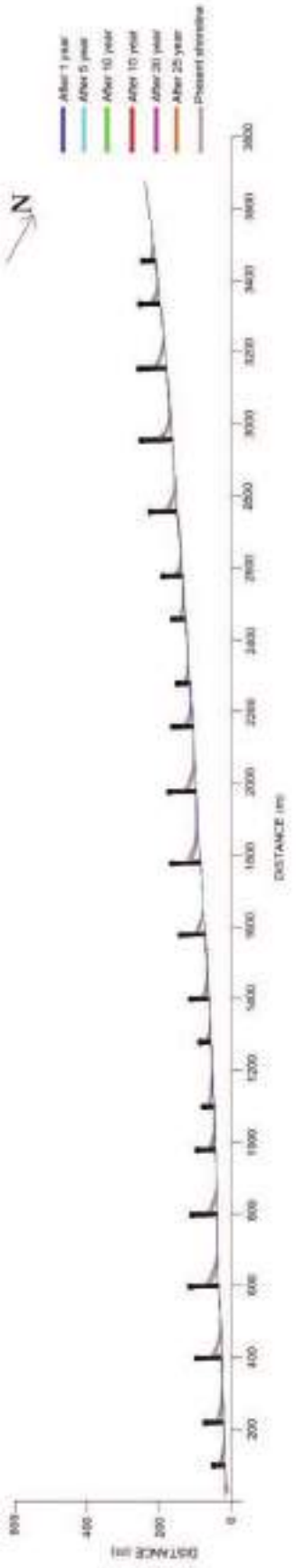


Fig. 74 Shoreline analysis for Saidh Mohammed beach 2 to Cherai beach

12.0 WAVE MODELLING

12.1 General

The study aims at providing an in-depth analysis on the wave characteristics along the proposed coastal protection measures between Valappu and Cherai Beach along the Ernakulam coastline. A suitable numerical model is required in order to carry out this task. For the present simulation, the well-known CGWAVE model has been used.

The nonlinear wave propagation associated with most of the observed phenomenon in the offshore region (e.g., wave reflection, refraction, and diffraction) is generally represented by the shallow water mild slope equation.

$$\nabla.\left(C_p C_g \nabla \eta\right) + k^2 C_p C_g \eta = 0 \qquad (11)$$

Where,

C_p and C_g are the wave celerity and group celerity respectively.

η is the water surface elevation.

k is the wave number.

For the computation of the nearshore wave field, this model (Eqn. (11)) is subjected to the proper boundary conditions. This is provided by the bathymetry and the shoreline.

A numerical method is required to solve the above Eqn. (11) for wave elevation. In this study, the Finite Element Method (herein abbreviated as FEM) is employed. This requires creating a mesh structure in the given computational domain. Upon creation of such a mesh, the domain is represented by nodal points which are connected with each other through the created mesh. The numerical solution of Eqn. (11) is sought in those nodes. This mesh has been generated using the commercial package GAMBIT. The procedure for generation of the grid in GAMBIT as follows:

- Based on the region of the sea whose analysis is required add a path in Google Earth software.
- Taking the two end nodes of the path draw a semicircle which would represent the domain for which the wave analysis is required.
- Choose the type of elements (tri/quad) and the sizing of mesh.
- Mesh will be generated from which we would be able to know significant wave height and phase at each node.

12.2 Details of the mesh structure

The CGWAVE model utilizes triangular mesh units in the computational domain. Due to the complexity of the shoreline geometry, an unstructured mesh is desired. Hence a triangular

unstructured mesh is generated in GAMBIT, mesh generation software. In such a mesh the nodal spacing is optimized so as to adapt to the nearby portion of the shoreline boundary.

12.3 Results and Discussion

A total number of five wave directions have been simulated in order to investigate the wave tranquility inside the proposed port region. The wave directions are chosen such that they represent an annual year. The wave period of the computations is given as 6s-12s to observe the wave climate. The wave phase diagram and the wave height distribution for different wave approach angles of **180^0, 200^0, 225^0, 250^0, 270^0** and **300^0** are computed for wave directional scenarios. The wave climates representing typical wave directions for Valappu beach beach, Malippuram, Veliyathaparambu, Puthenkadappuram, Pazhangadu, Saidh Mohammed beach and phase 1 of Saidh Mohammed beach 2 to Cherai Beach.

12.4 Valappu Beach

The study aims at providing an in-depth analysis on the wave characteristics along the geo containers at (-5 m) at Valappu beach beach**.**

12.4.1 Computational domain

The computational domain roughly approximates a semi-circle of radius of 2.5 km. **Fig.75** shows the domain where the computations are performed. The direction of the incident monochromatic wave is defined with respect to the geometric northern direction.

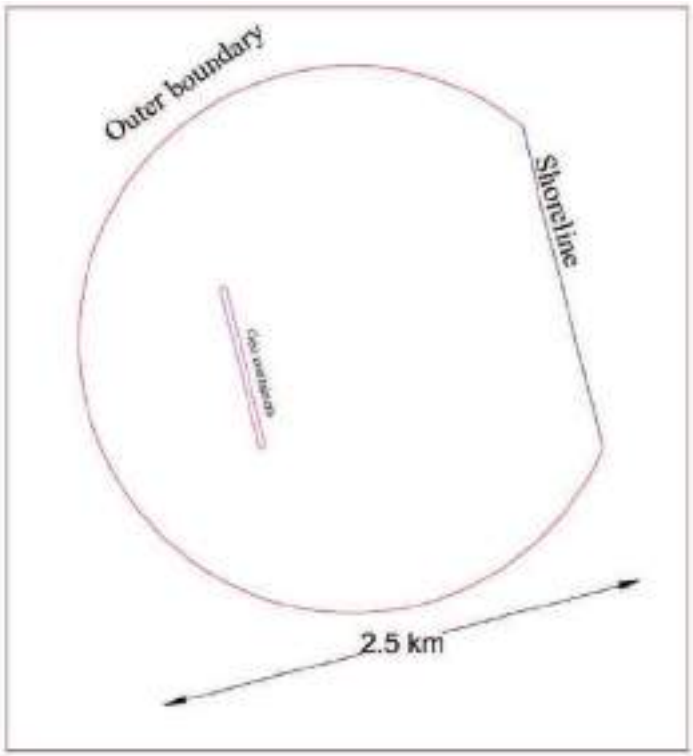


Fig.75 Computational domain

The outer semi-circular periphery is modelled by 1346 nodes with a spacing of 5m and the inner shoreline is modelled by nodes with a spacing of 5m. Then an unstructured mesh is created with an average spacing of 5m inside the domain. This leads to a total number of 248990 nodes with 495972 numbers of triangular elements. The mesh is shown in **Fig. 76.**

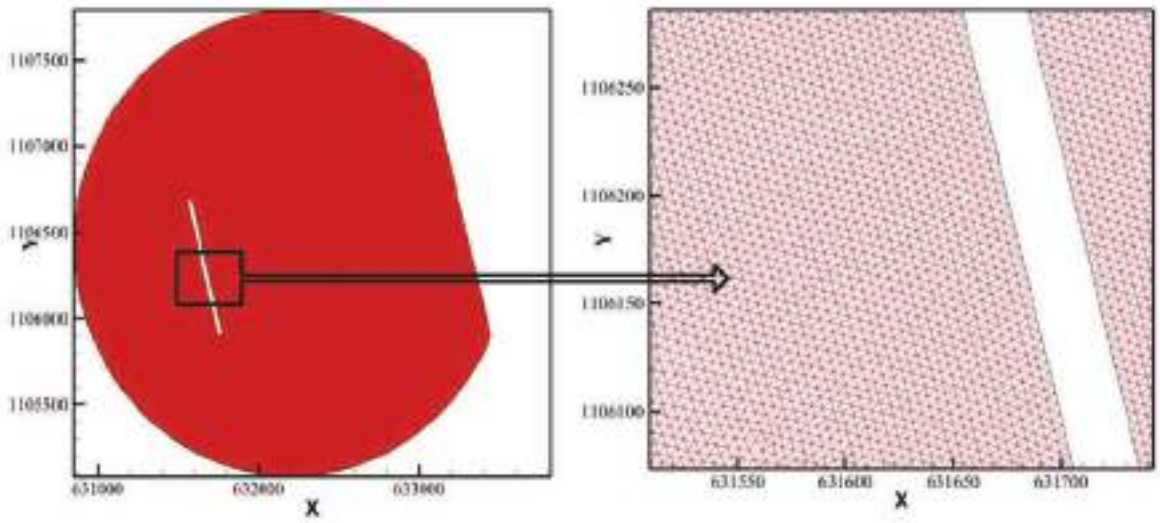
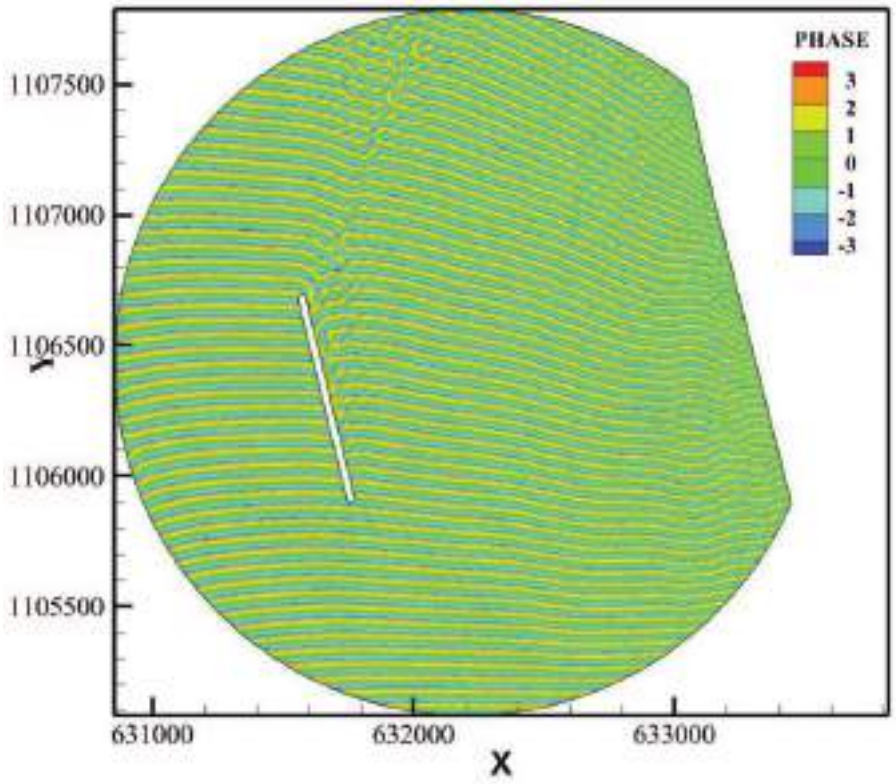


Fig.76 Mesh Structure adopted for the wave propagation modelling

12.4.2 Results for Valappu beach



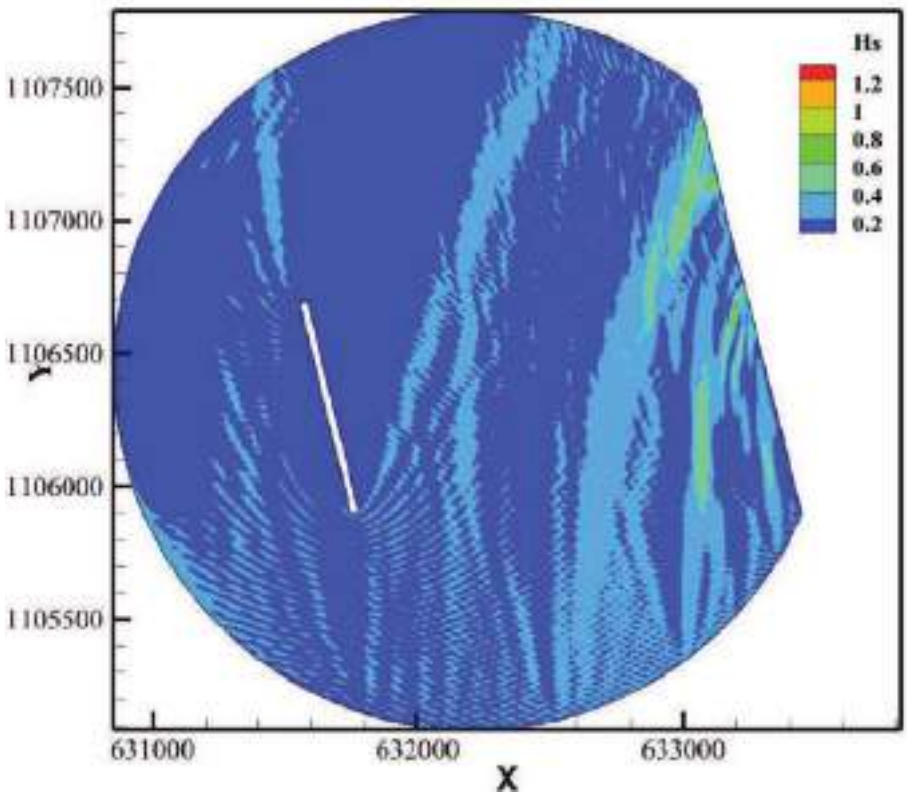
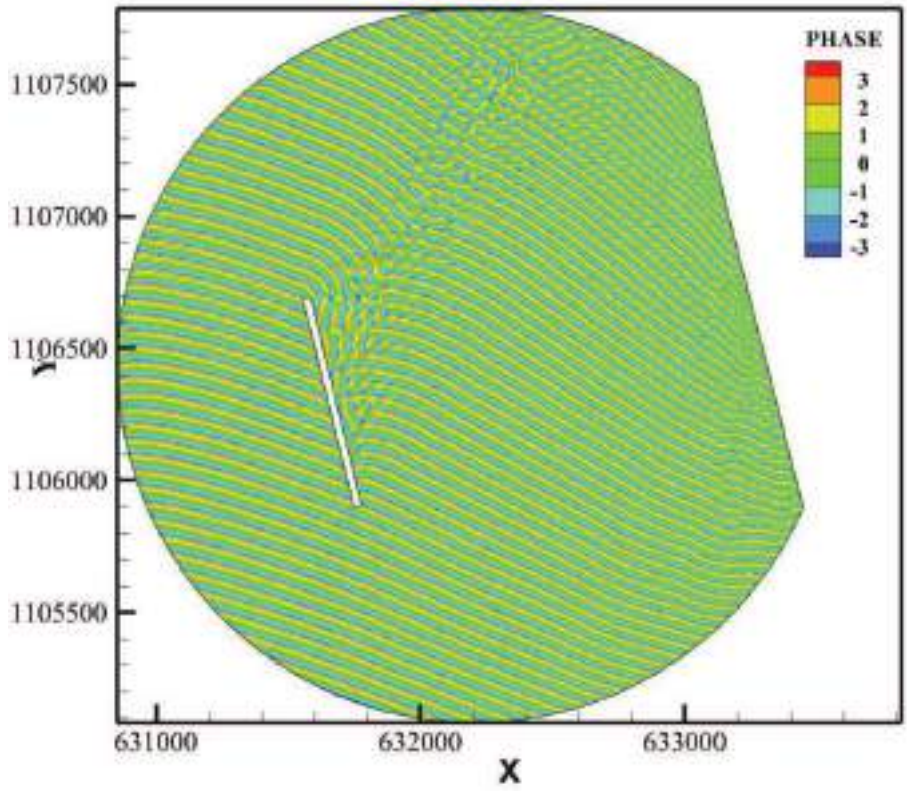


Fig.77a Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 180^0



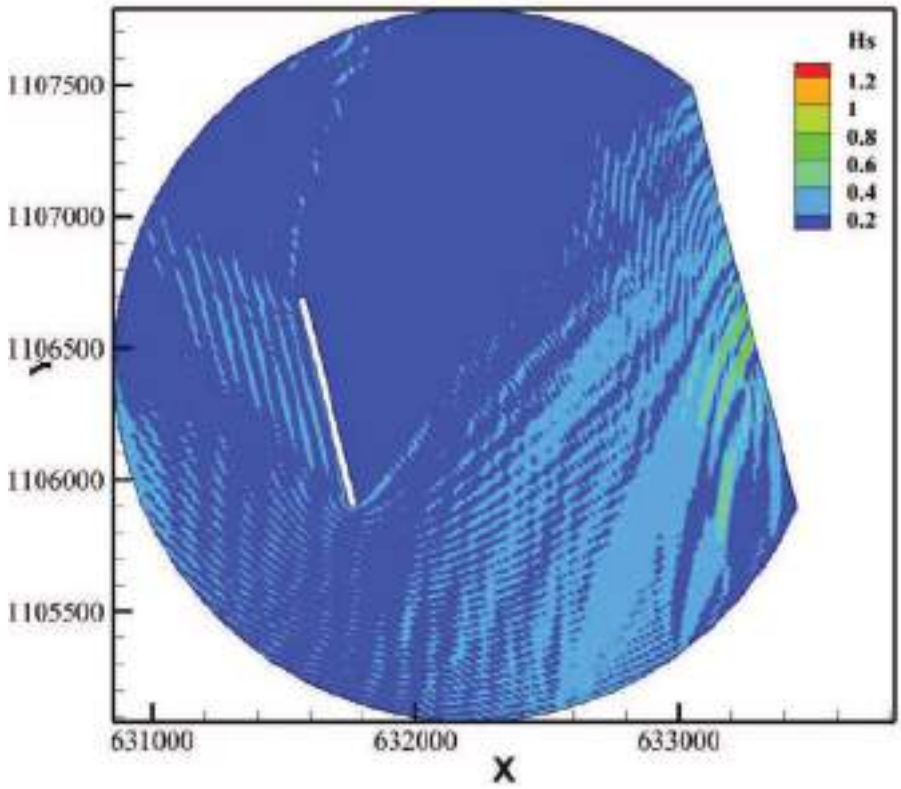
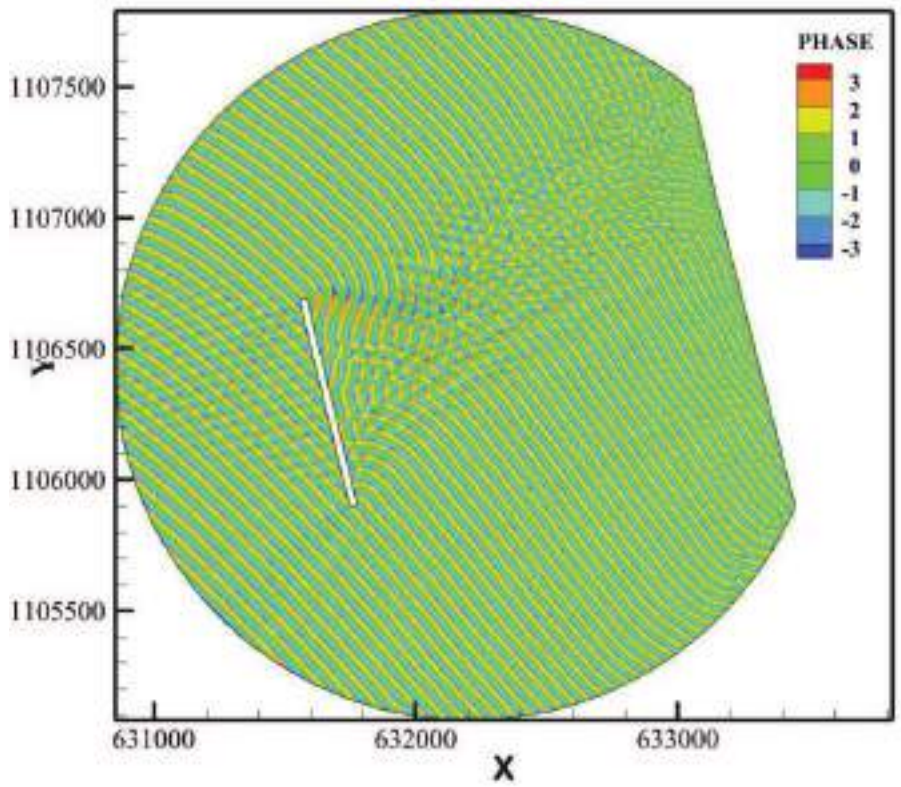


Fig.77b Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 200^0



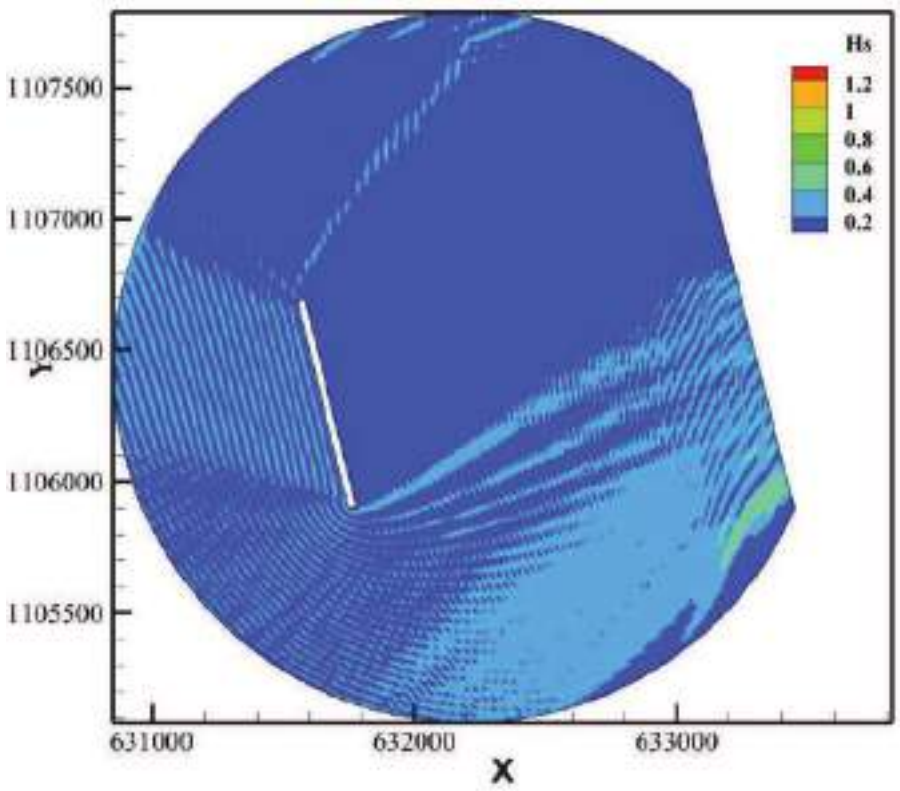
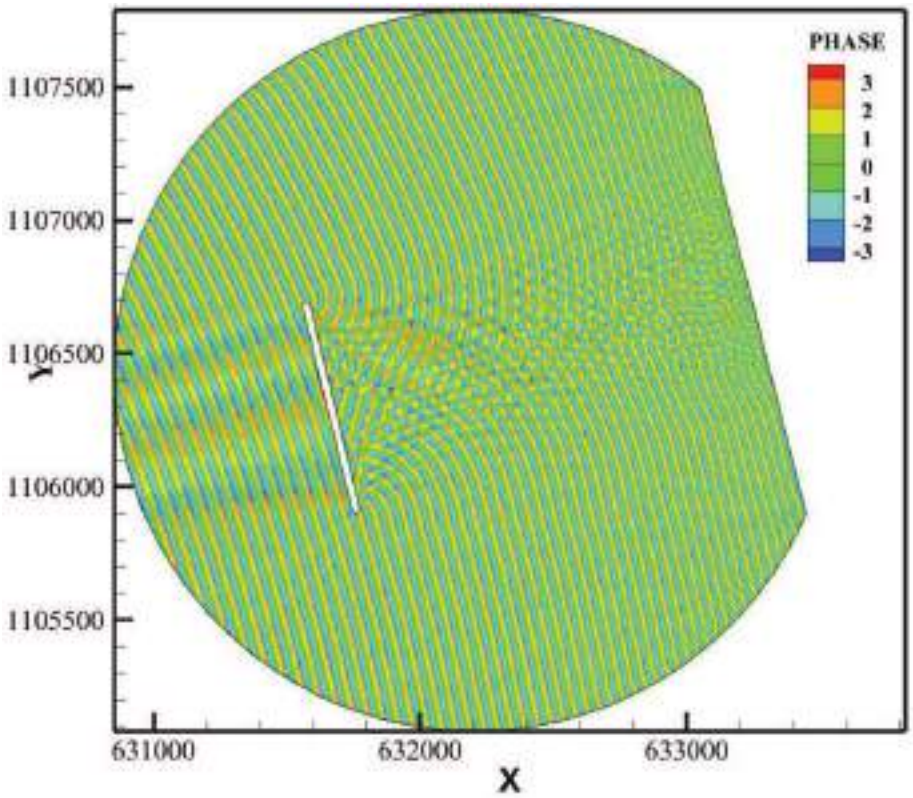


Fig.77c Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 225^0



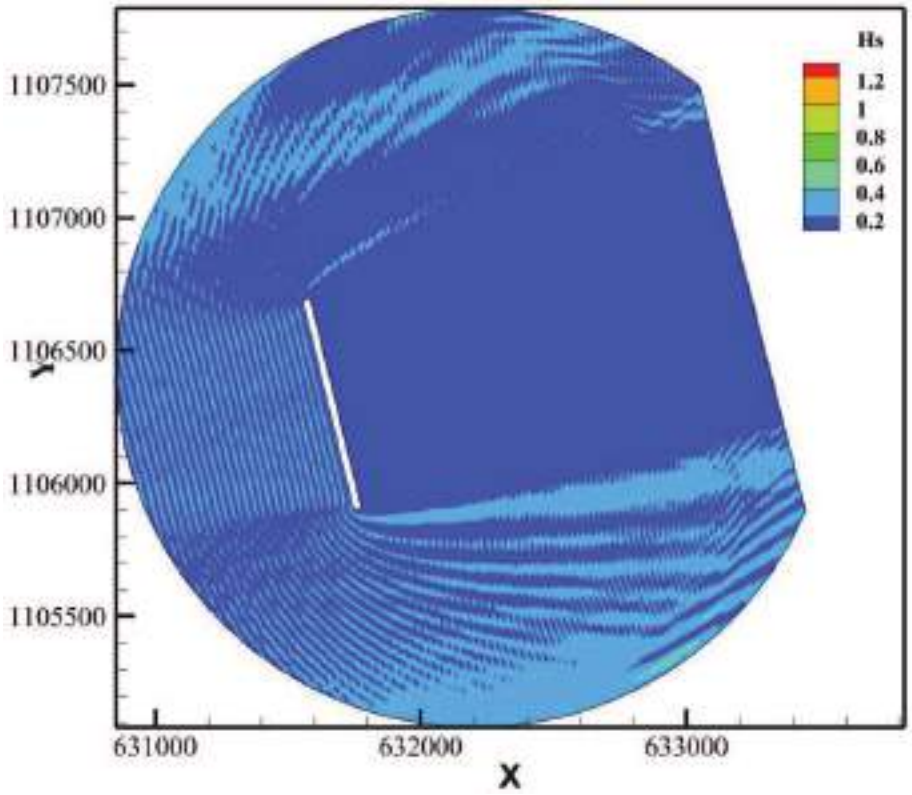
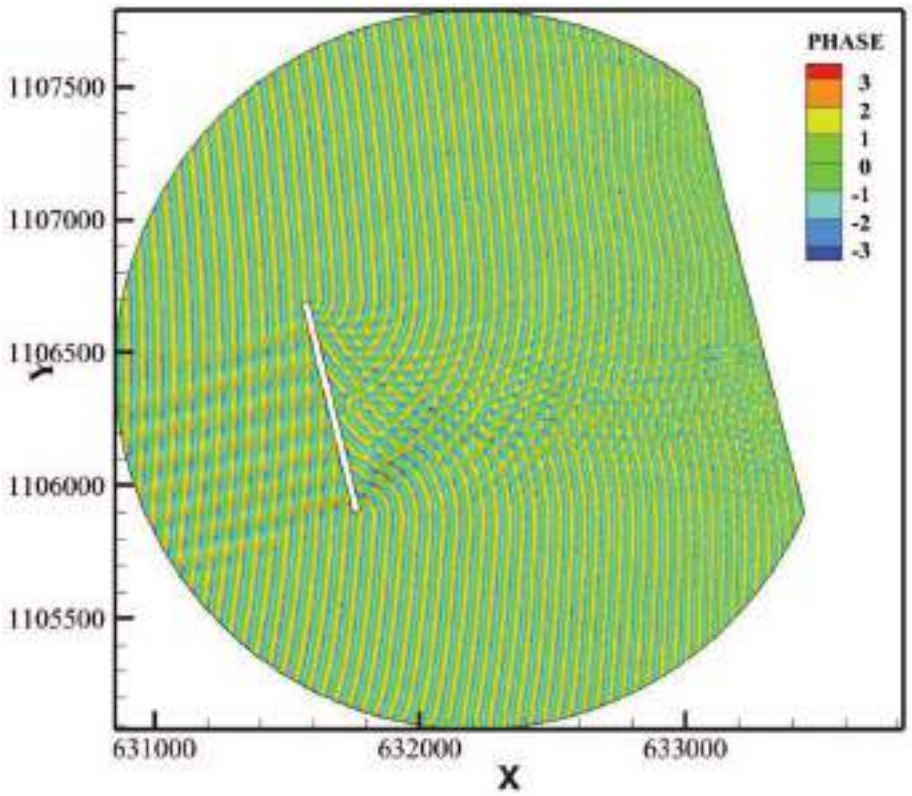


Fig.77d Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 250^0



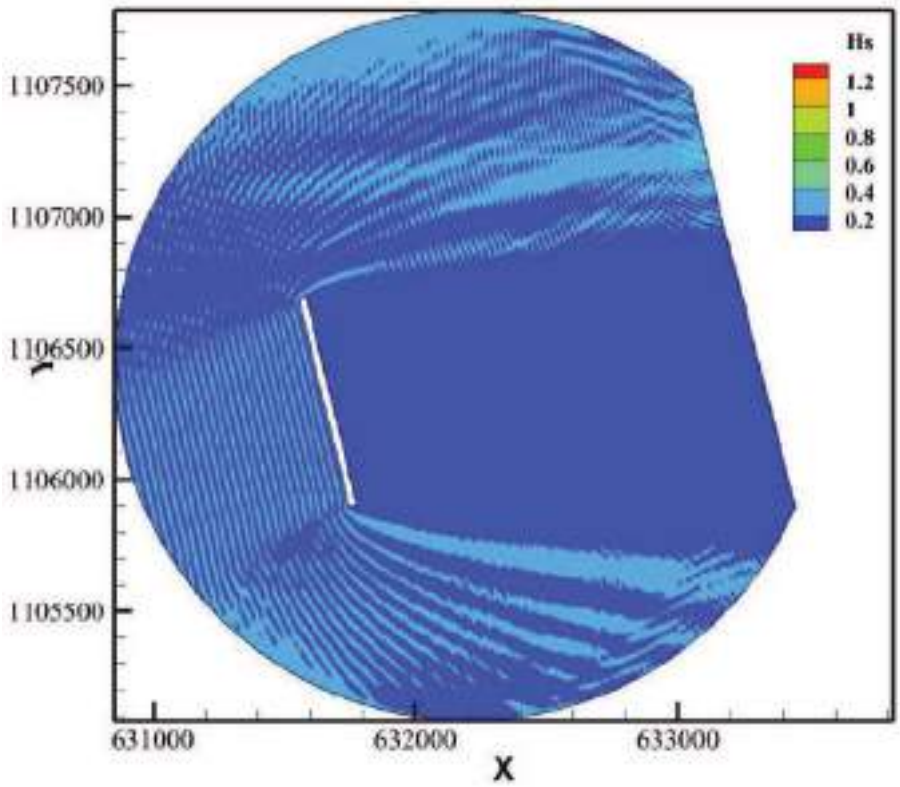
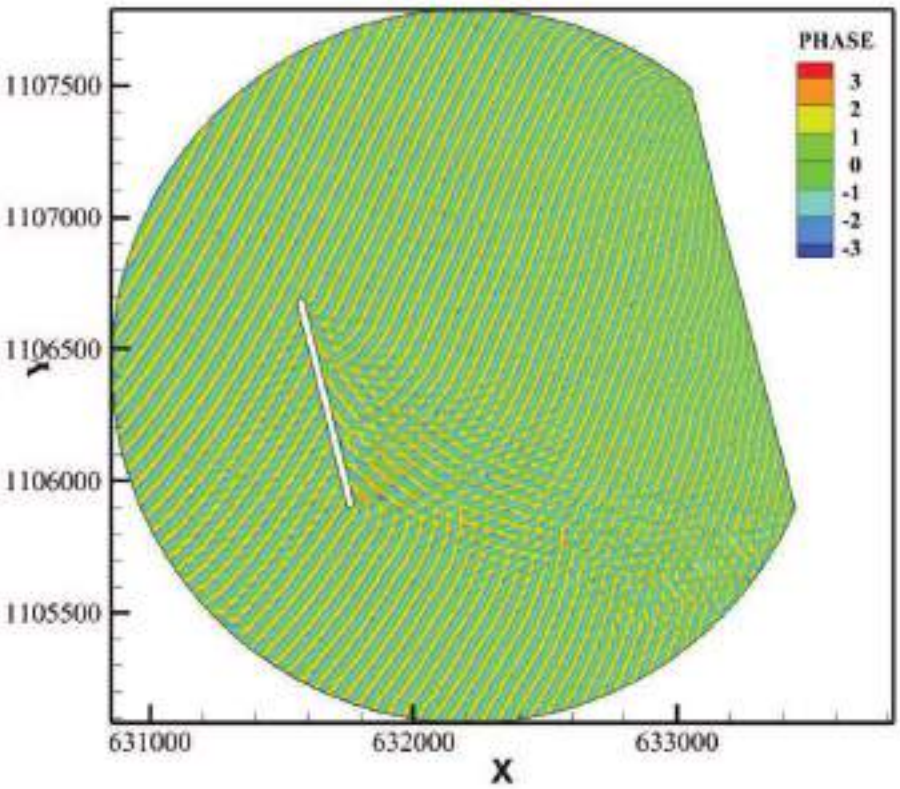


Fig.77e Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 270^0



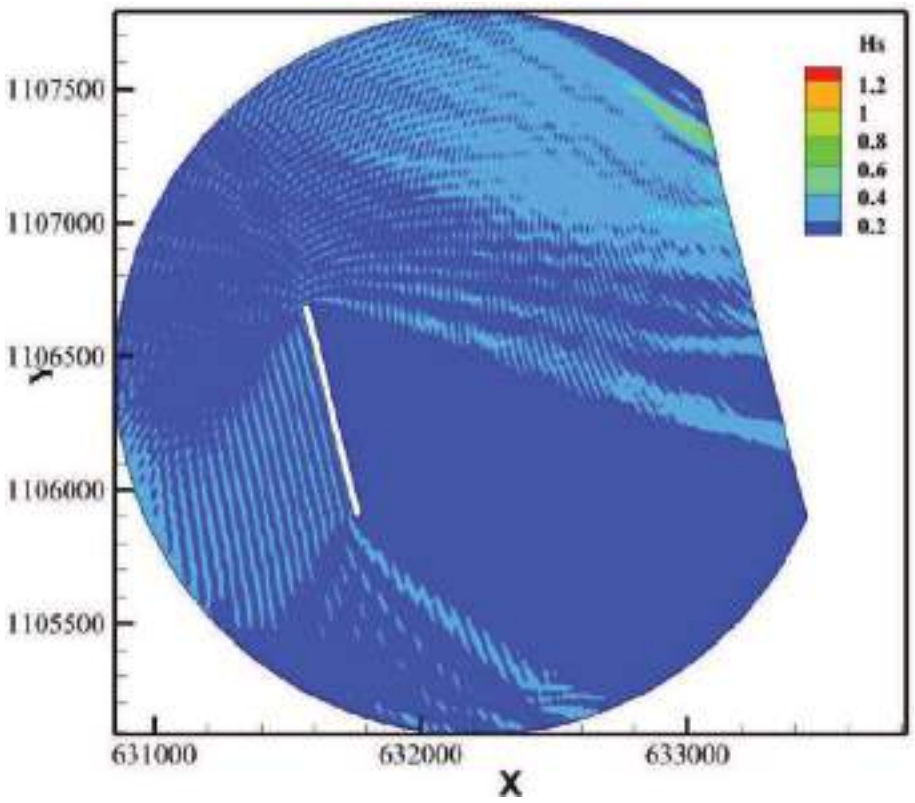


Fig.77f Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 300^0

12.5 Malippuram

The study aims at providing an in-depth analysis of the wave characteristics along the Groyne field at Malippuram.

12.5.1 Computational domain

The computational domain roughly approximates a semi-circle of radius 2 km. **Fig.78** shows the domain where the computations are performed. The direction of the incident monochromatic wave is defined with respect to the geometric northern direction.

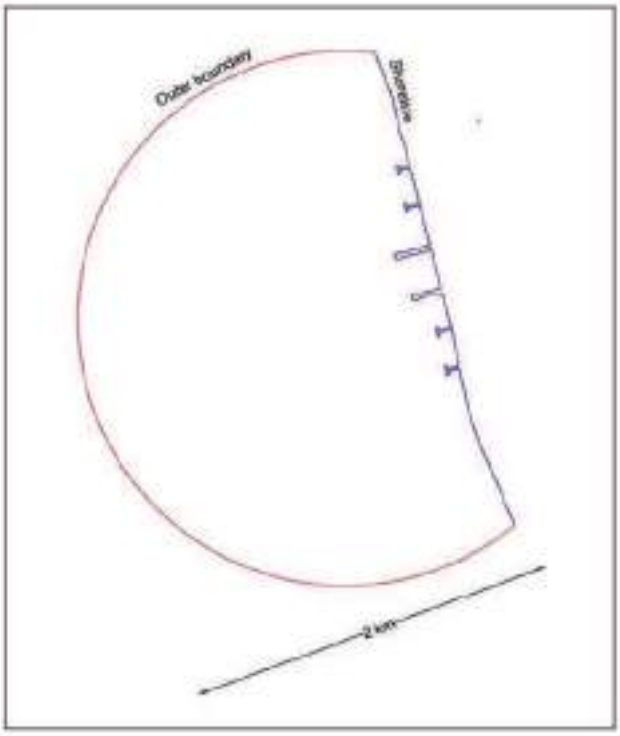


Fig.78 Computational domain

The outer semi-circular periphery is modelled by 956 nodes with a spacing of 5m and the inner shoreline is modelled by nodes with a spacing of 5m. Then an unstructured mesh is created with an average spacing of 5m inside the domain. This leads to a total number of 158533 nodes with 315368 numbers of triangular elements. The mesh is shown in **Fig. 79.**

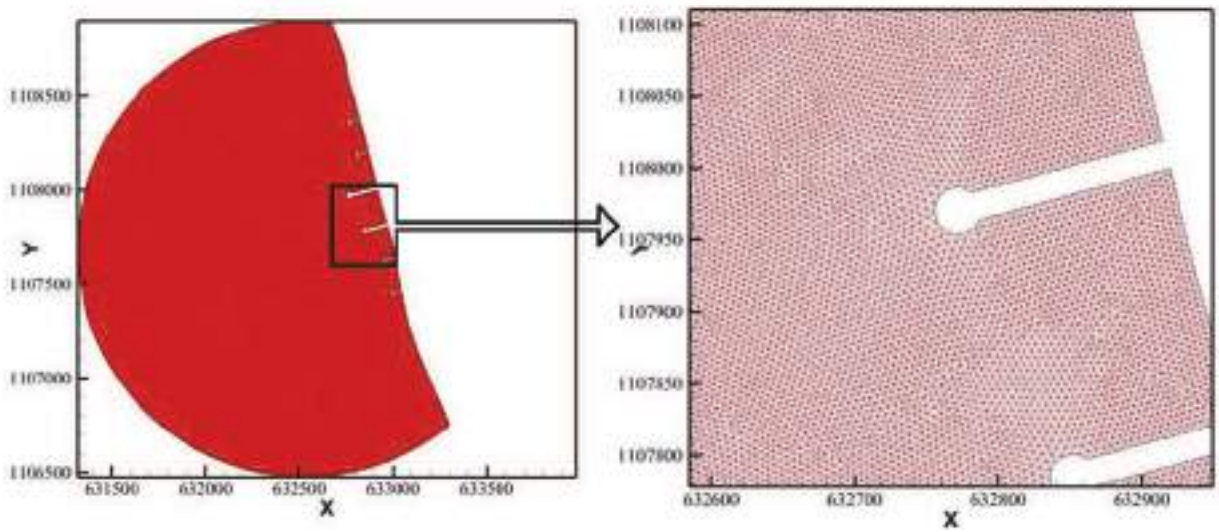


Fig.79 Mesh Structure adopted for the wave propagation modeling

12.5.2 Results for Malippuram

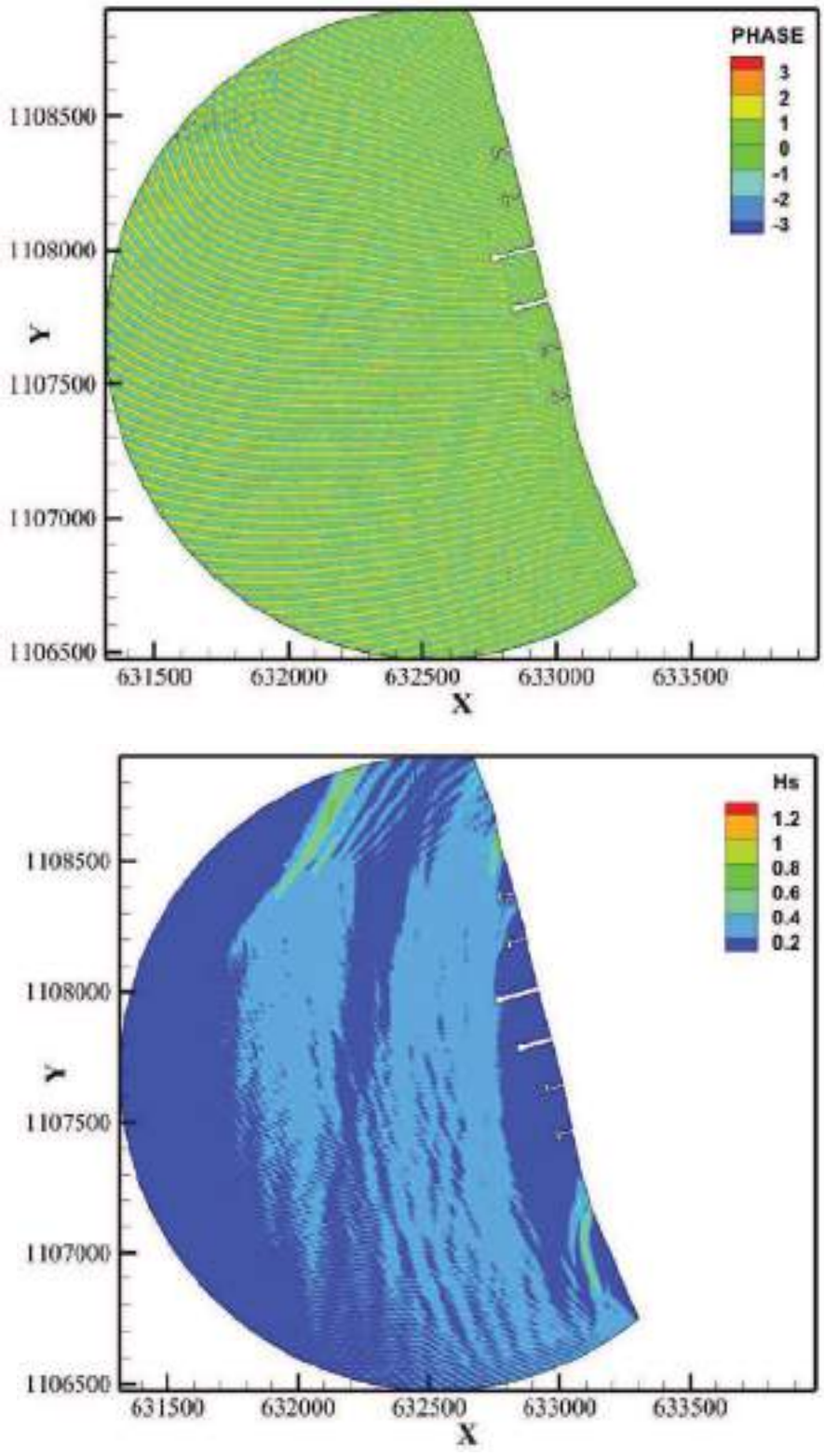
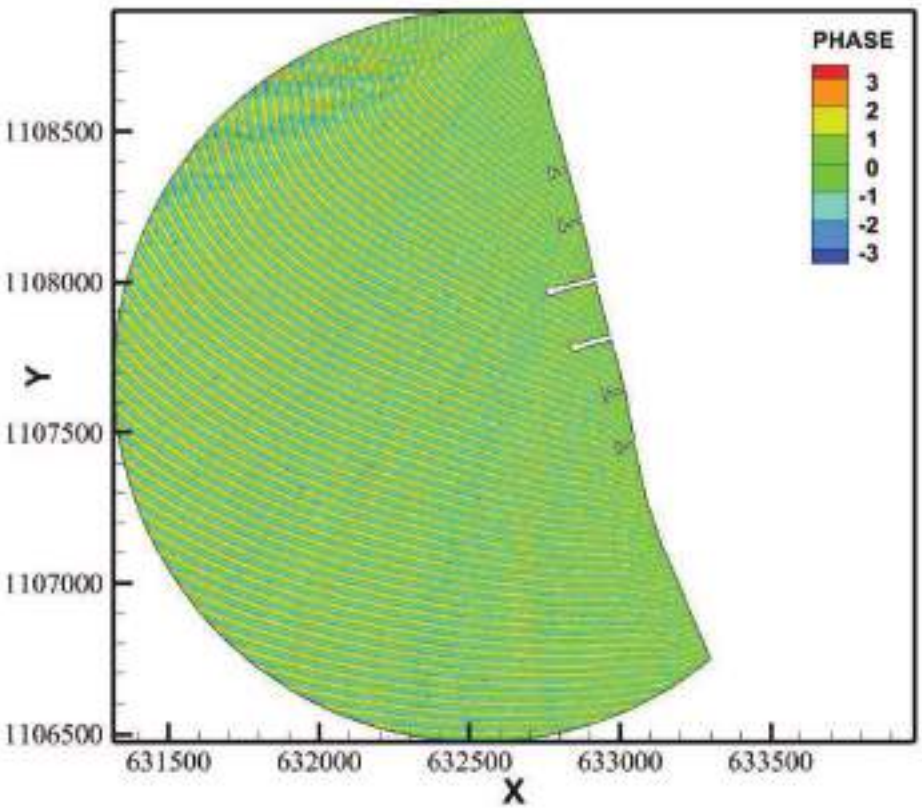


Fig.80a Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 180^0



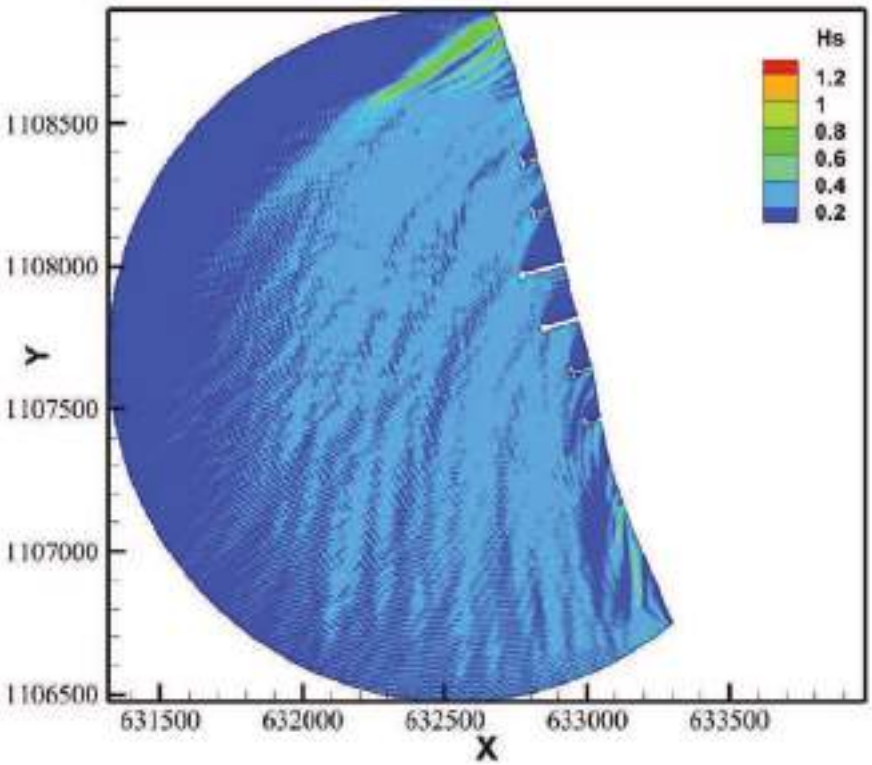
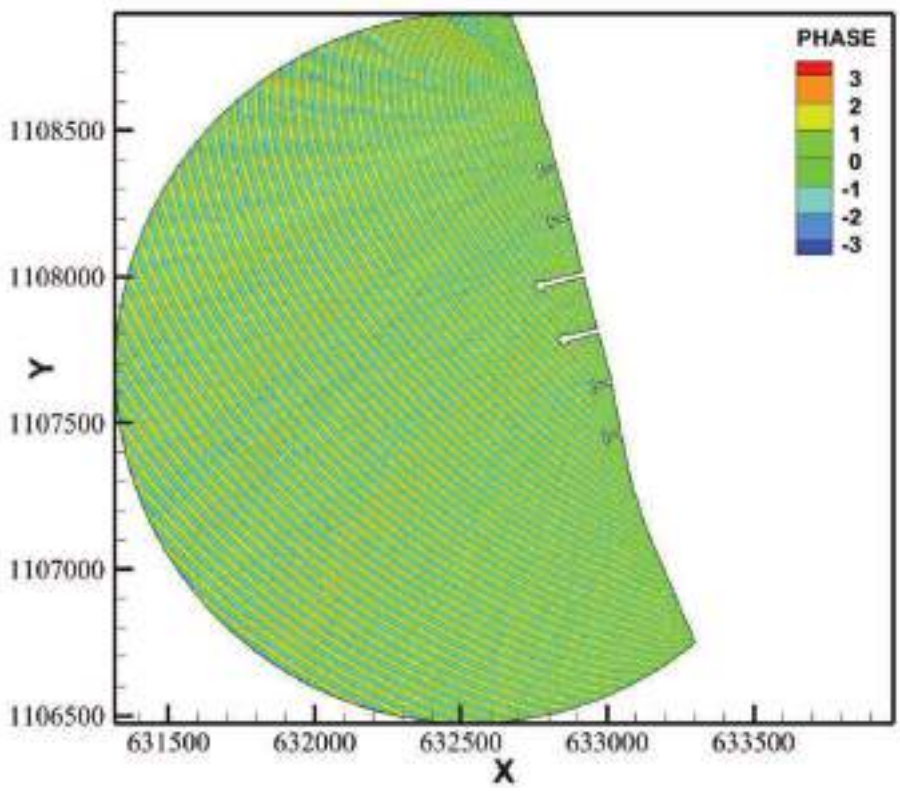


Fig.80b Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 200^0



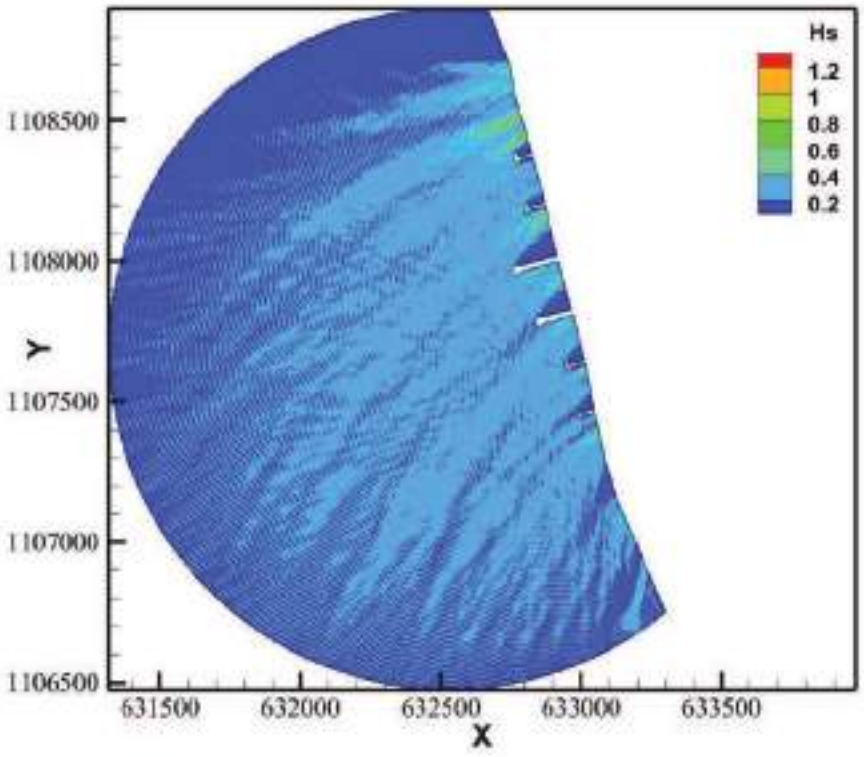


Fig.80c Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 225^0

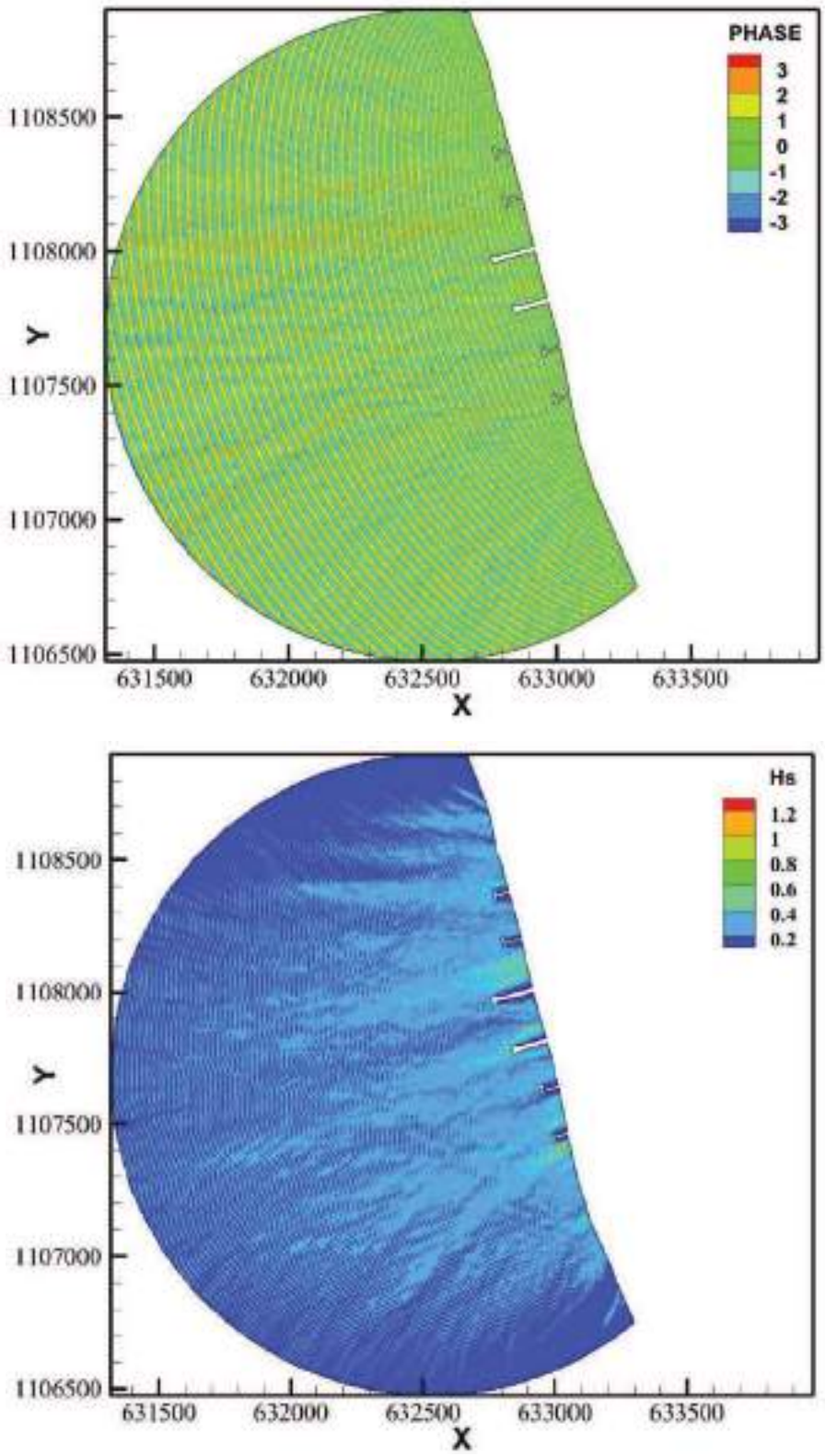


Fig.80d Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 250^0

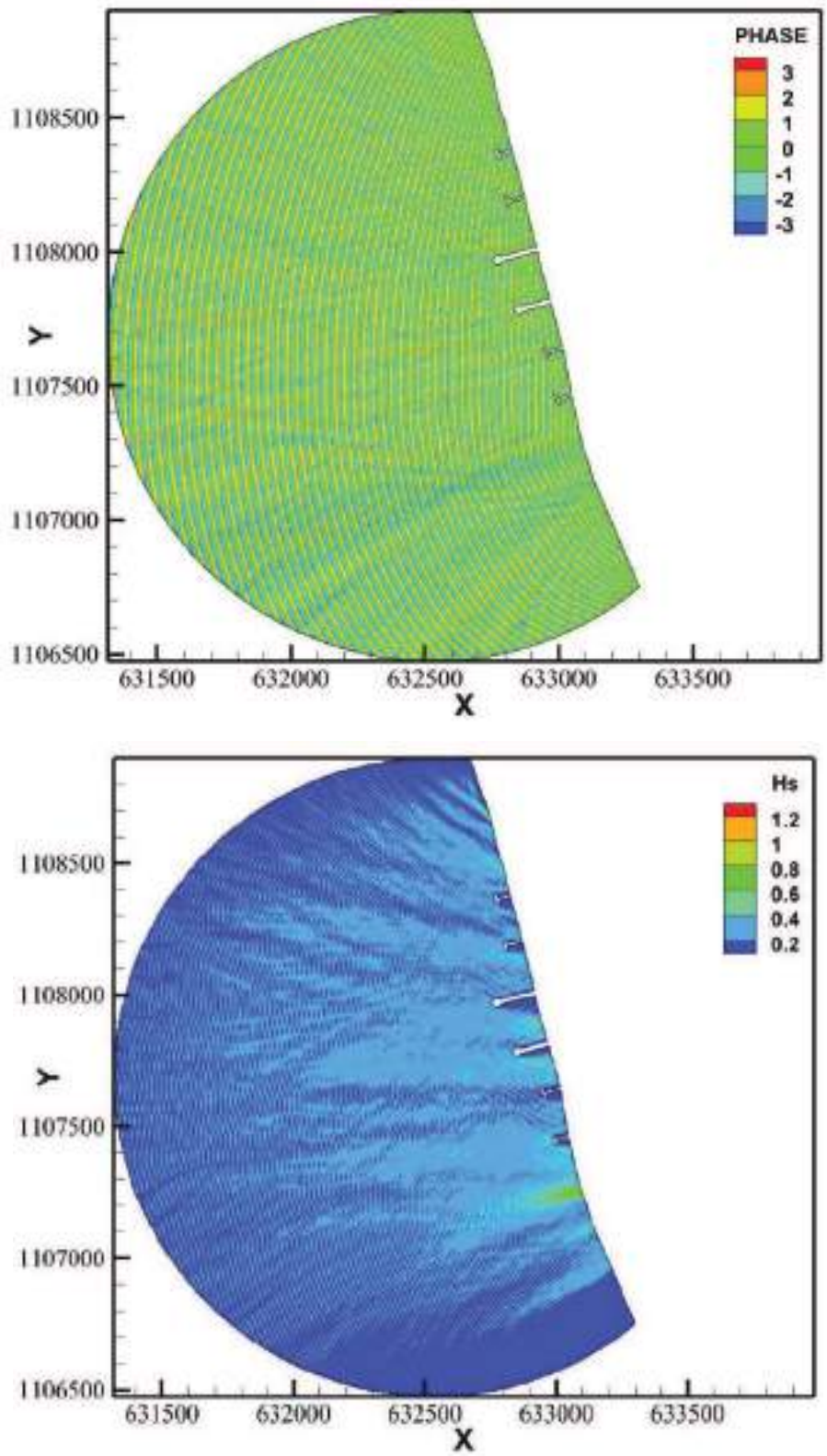


Fig.80e Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 270^0

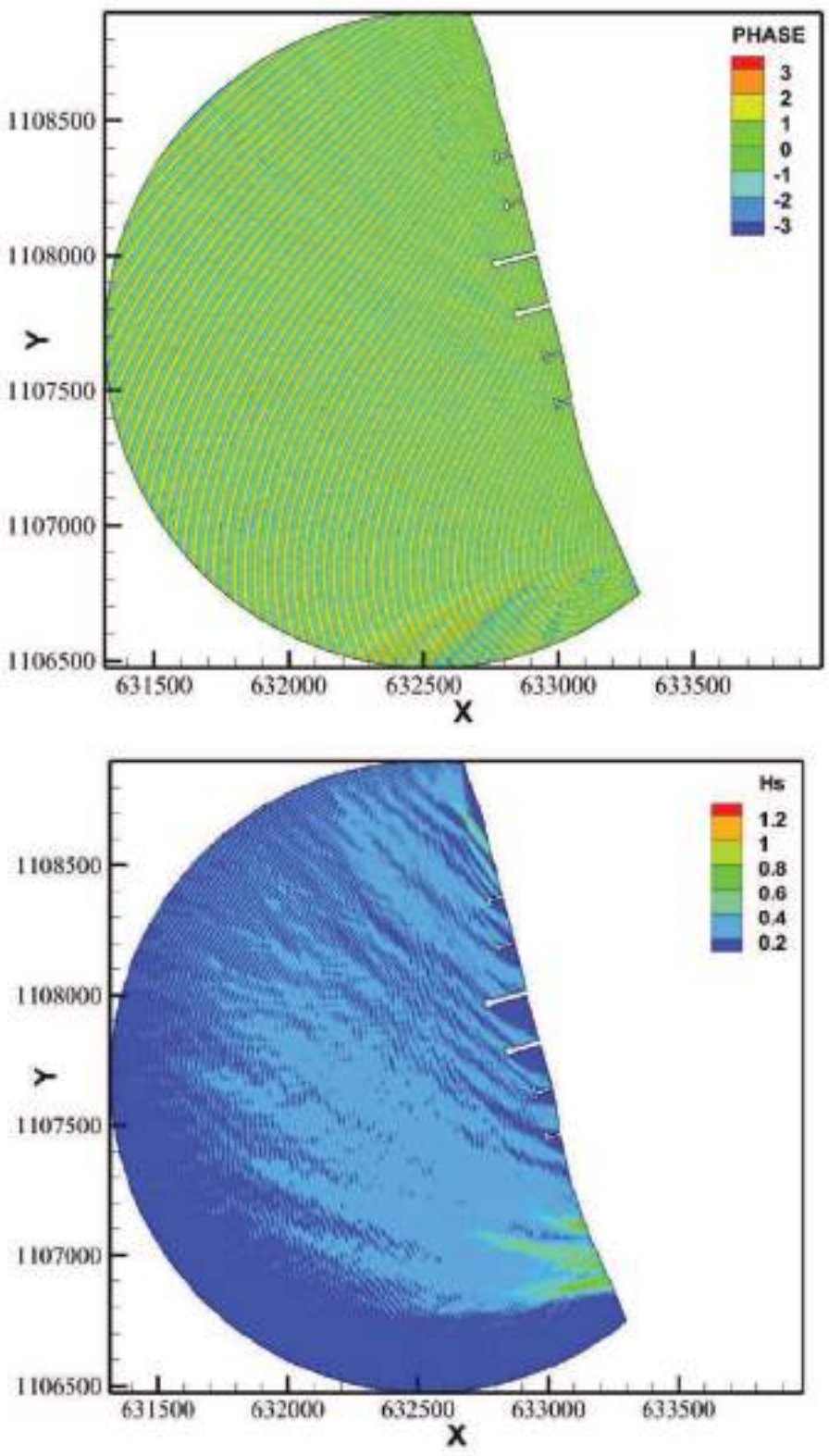


Fig.80f Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 300^0

12.6 Veliyathamparambu

The study aims at providing an in-depth analysis on the wave characteristics along the Groyne field at Veliyathamparambu.

12.6.1 Computational domain

The computational domain roughly approximates a semi-circle of radius 1.5 km. **Fig.81** shows the domain where the computations are performed. The direction of the incident monochromatic wave is defined with respect to the geometric northern direction.

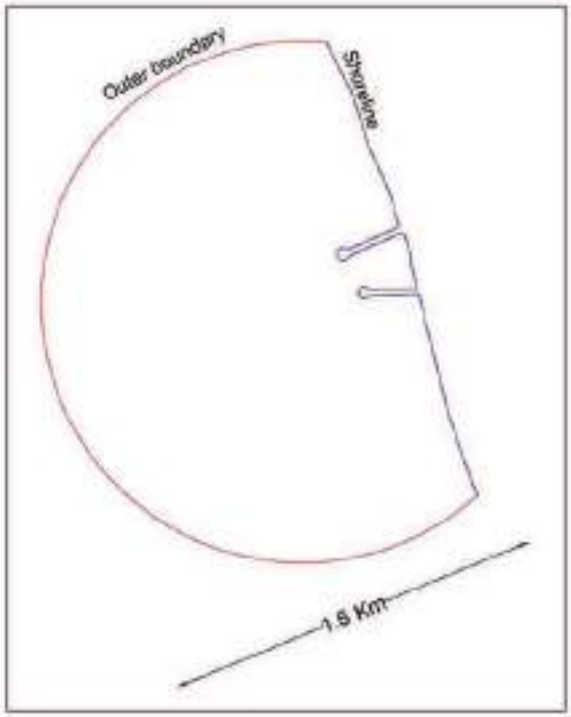


Fig. 81 Computational domain

The outer semi-circular periphery is modelled by 661 nodes with a spacing of 5m and the inner shoreline is modelled by nodes with a spacing of 5m. Then an unstructured mesh is created with an average spacing of 5m inside the domain. This leads to a total number of 76290 nodes with 151442 numbers of triangular elements. The mesh is shown in **Fig. 82.**

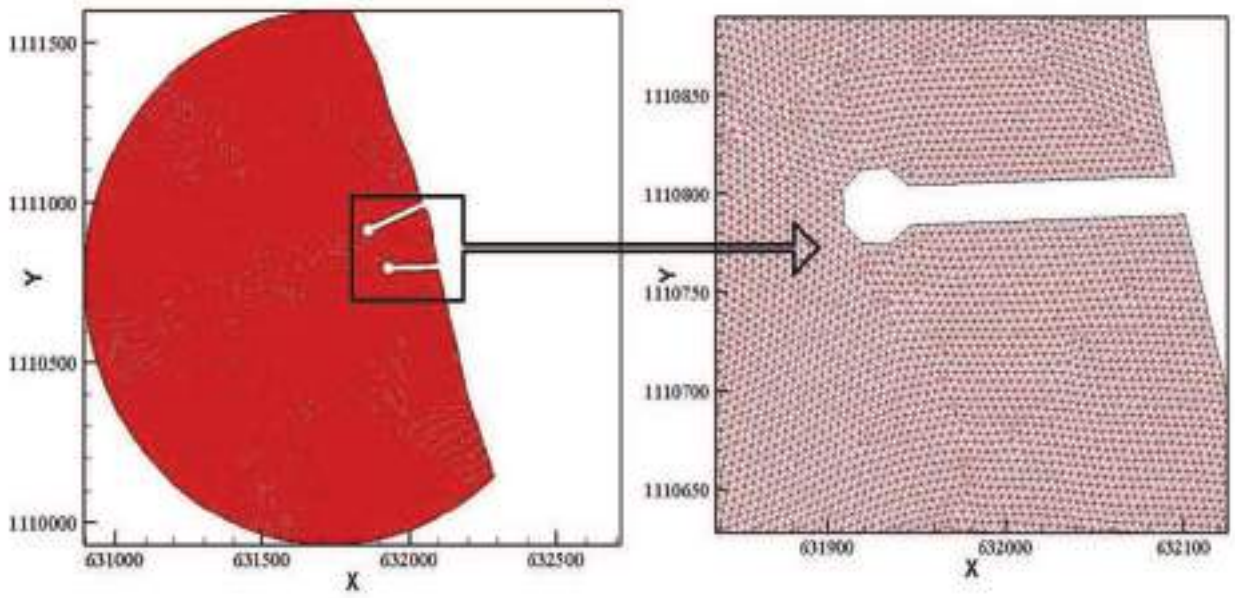
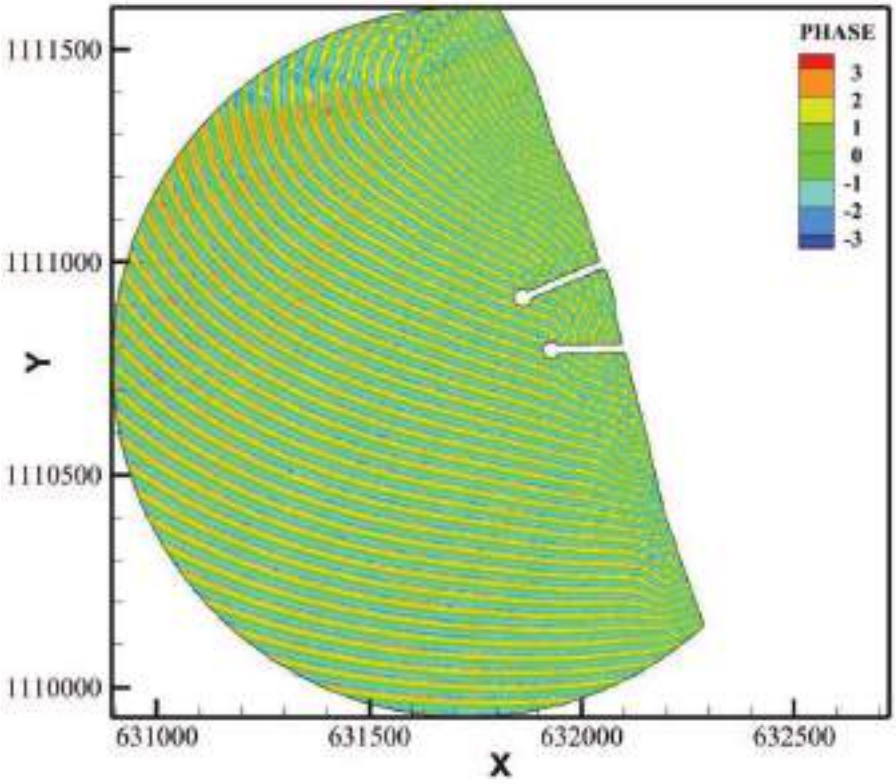


Fig.82 Mesh Structure adopted for the wave propagation modeling

12.6.2 Results for Veliyathamparambu



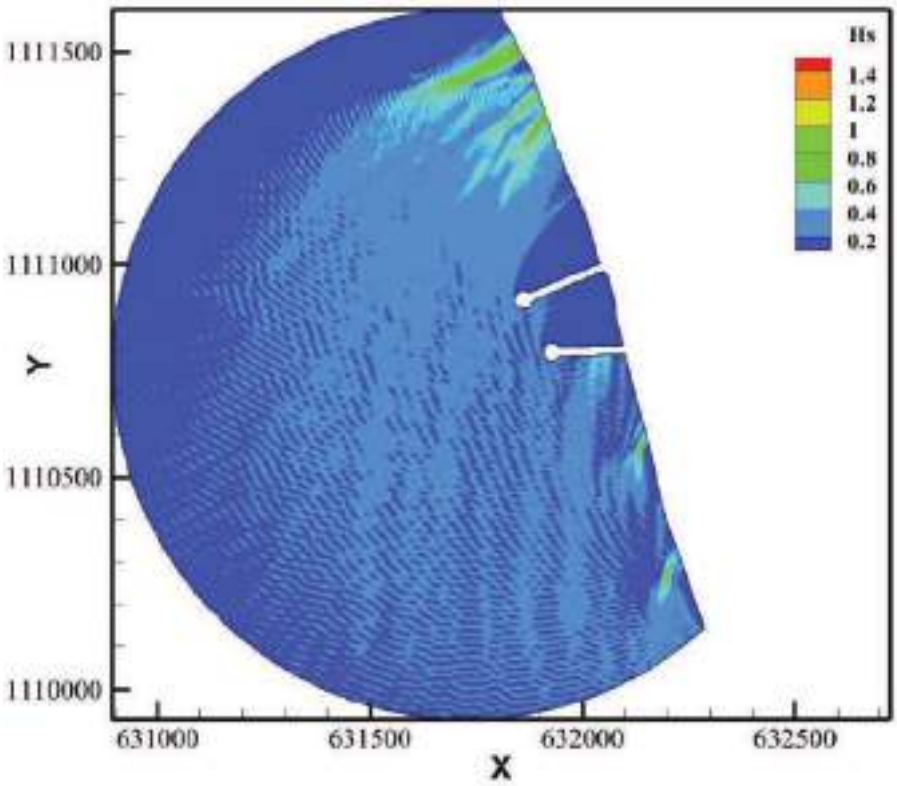
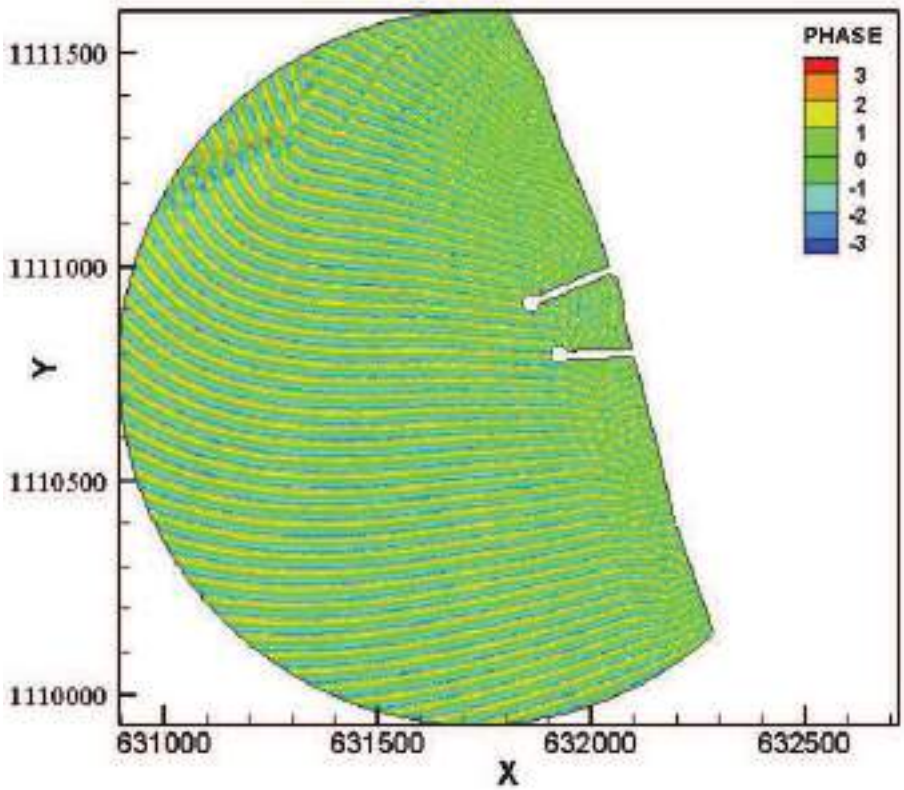


Fig.83a Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 180^0



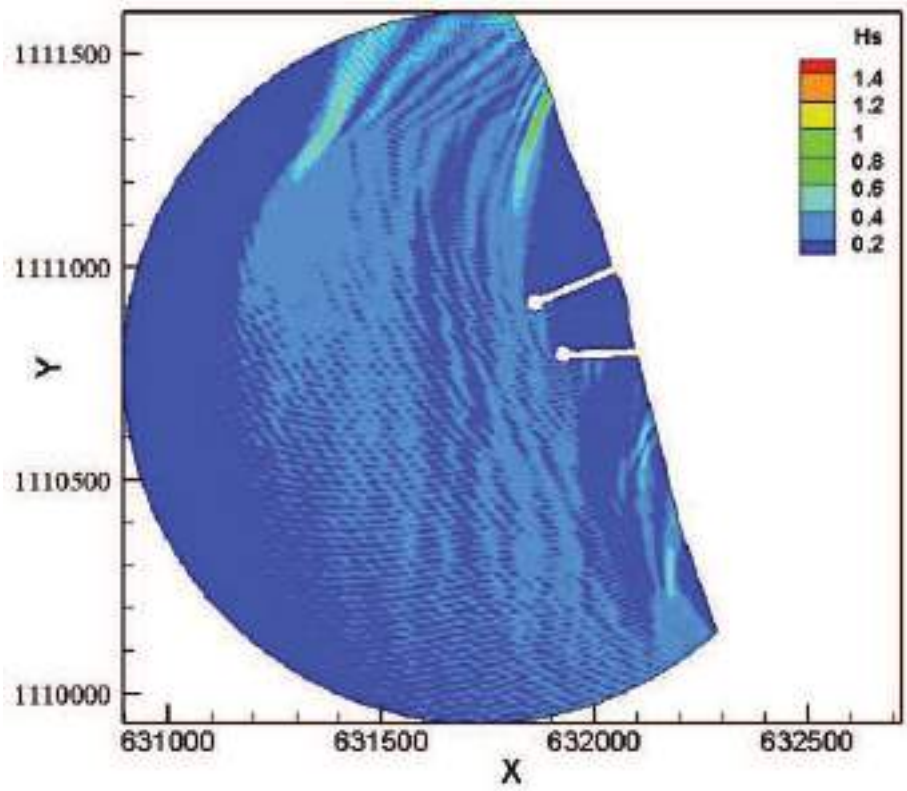
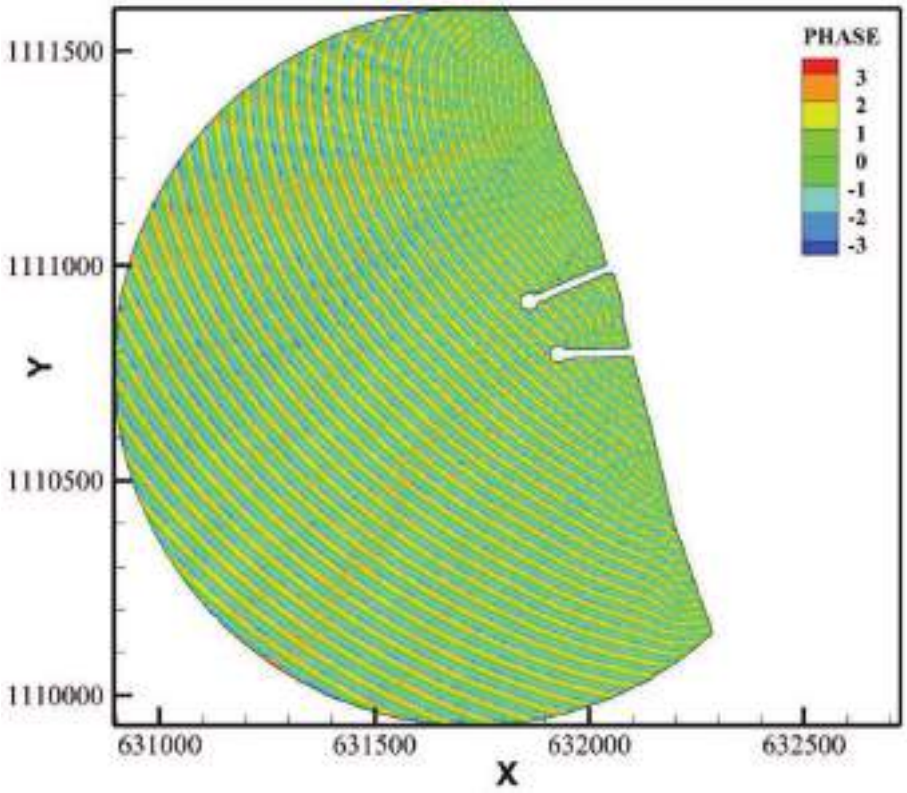


Fig.83b Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 200^0



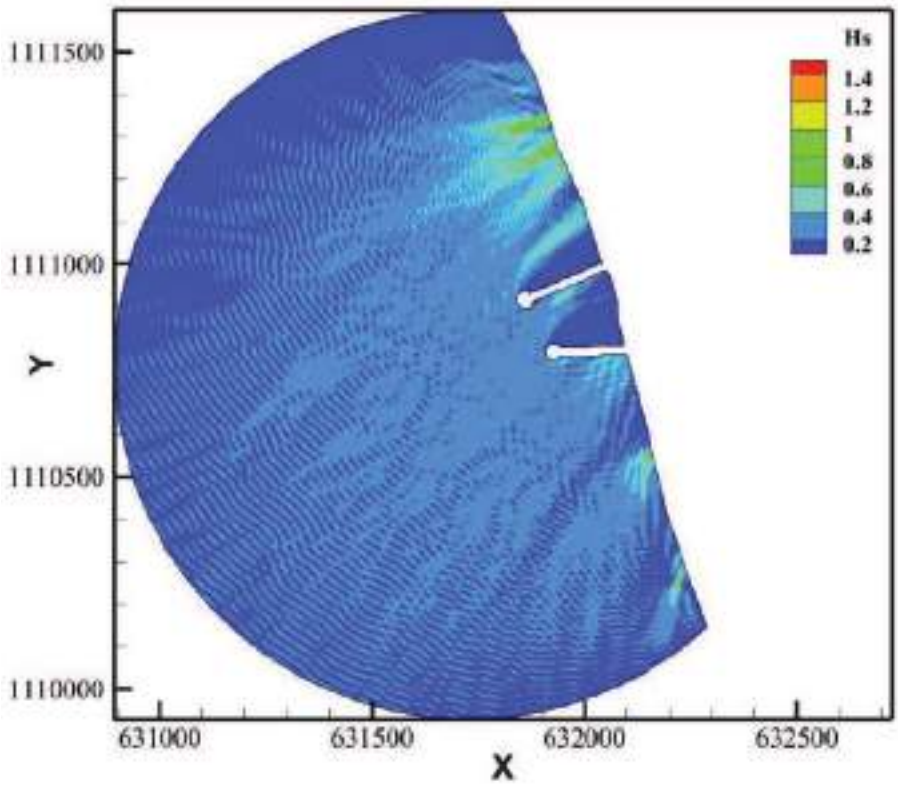
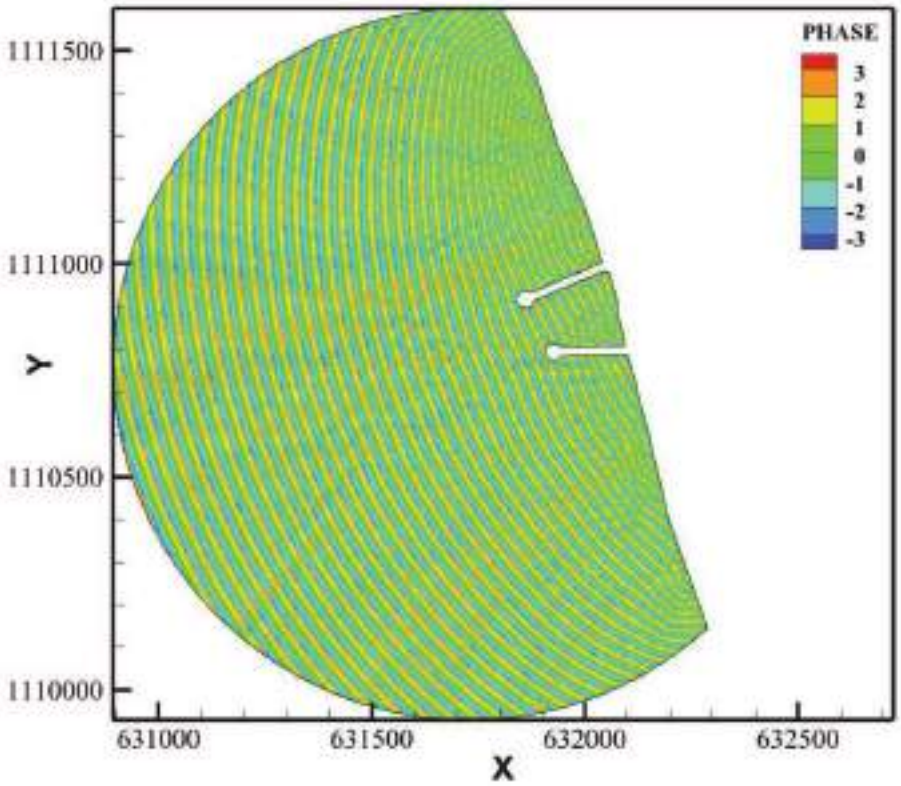


Fig.83c Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 225^0



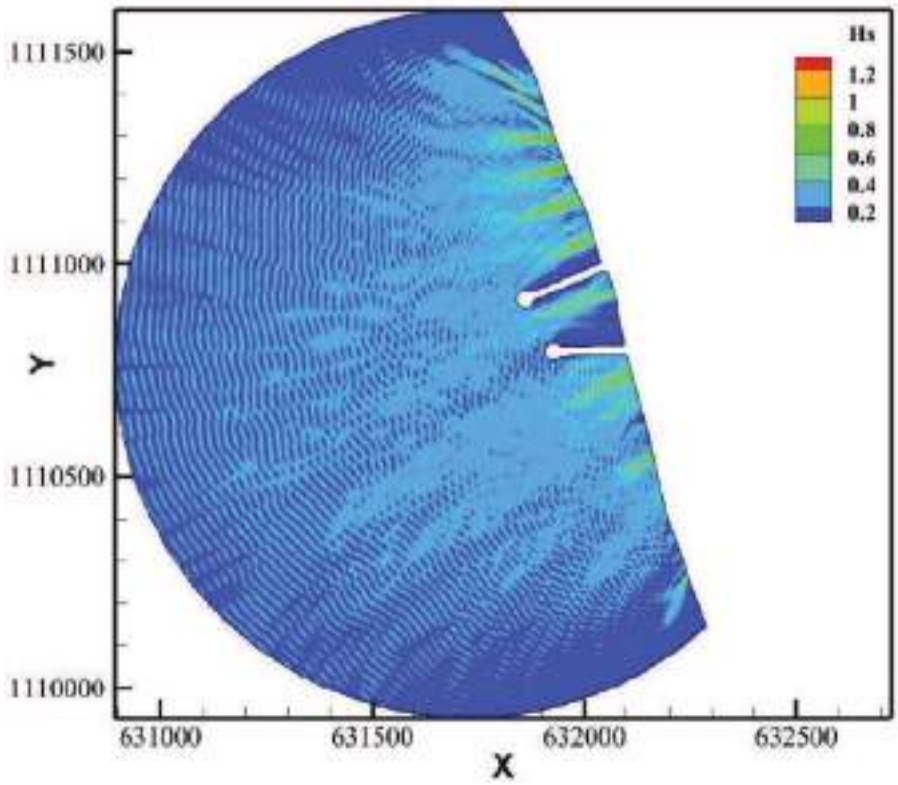
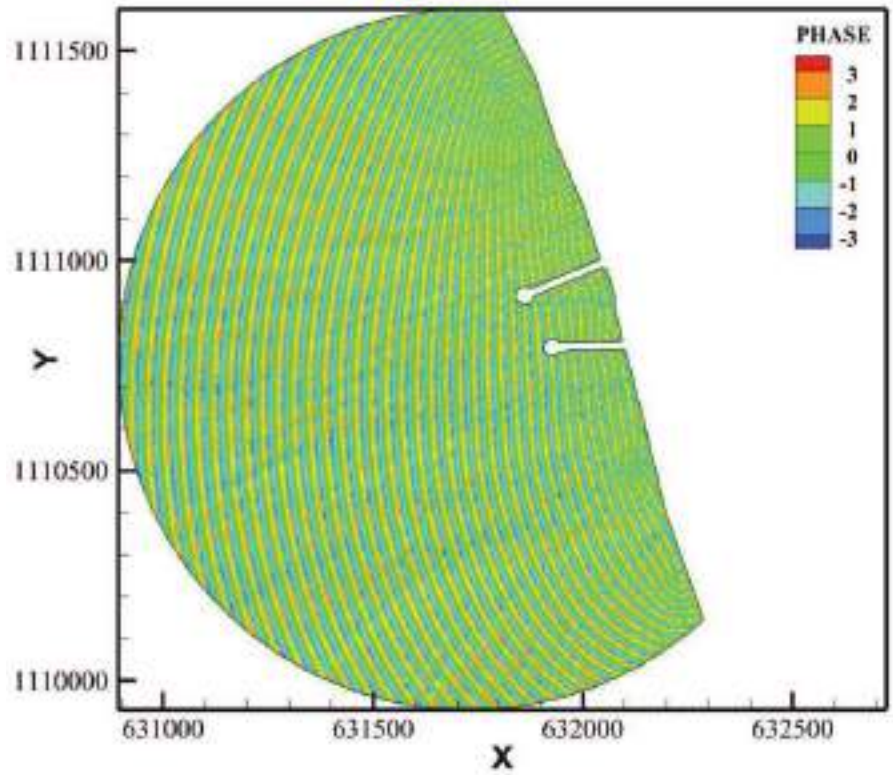


Fig.83d Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 250^0



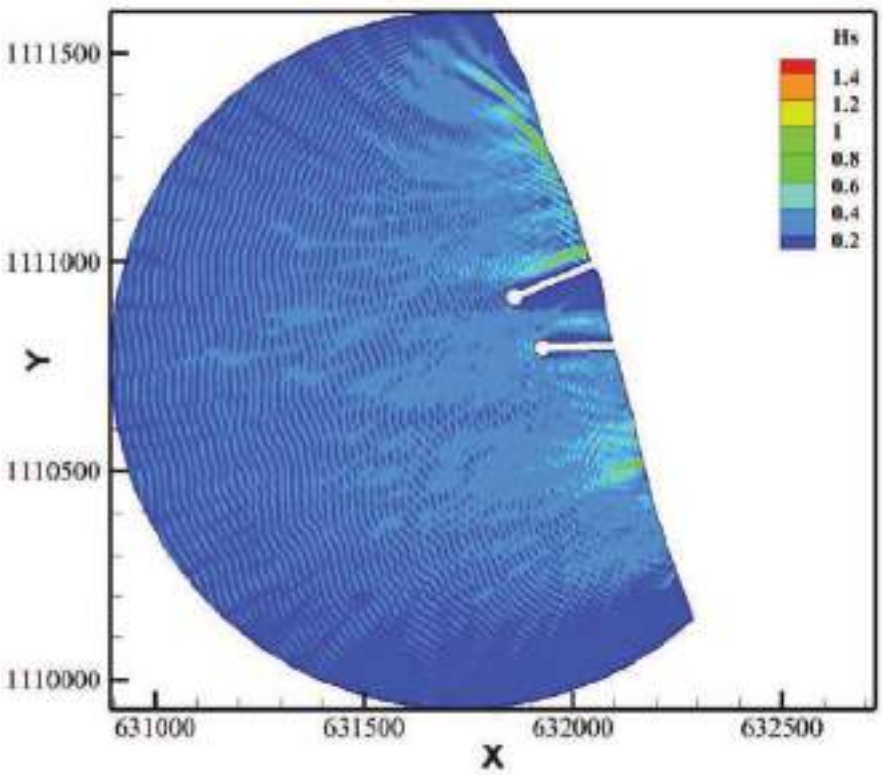
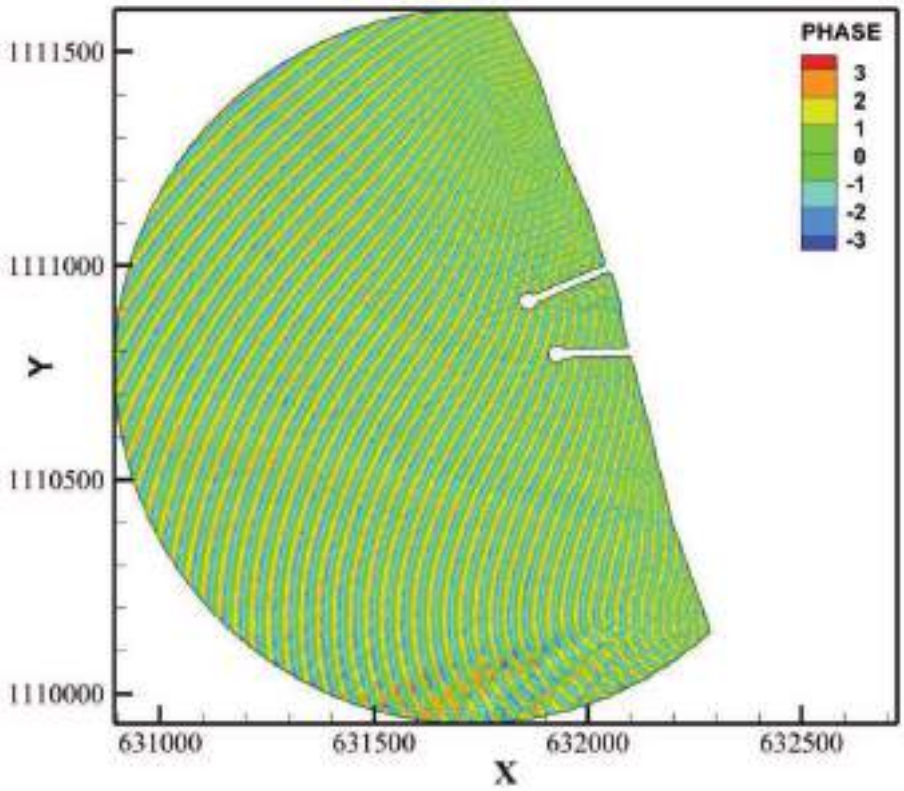


Fig.83e Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 270^0



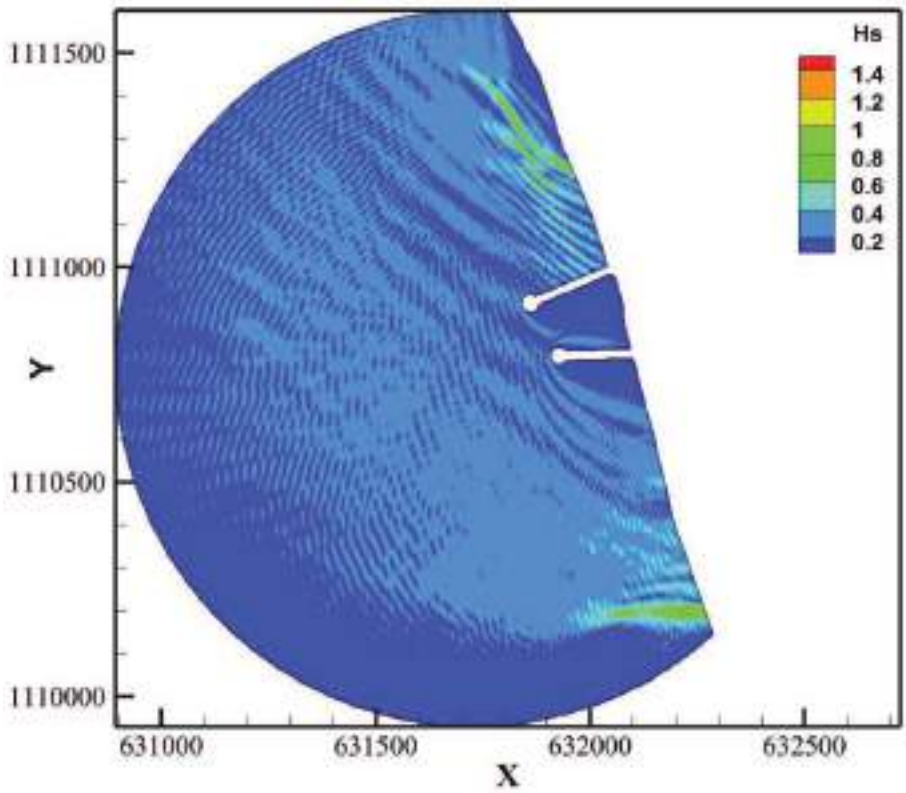


Fig.83f Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 300^0

12.7 Puthenkadappuram

The study aims at providing an in-depth analysis on the wave characteristics along the Groyne field at Puthenkadappuram**.**

12.7.1 Computational domain

The computational domain roughly approximates a semi-circle of radius 2 km. **Fig.84** shows the domain where the computations are performed. The direction of the incident monochromatic wave is defined with respect to the geometric northern direction.

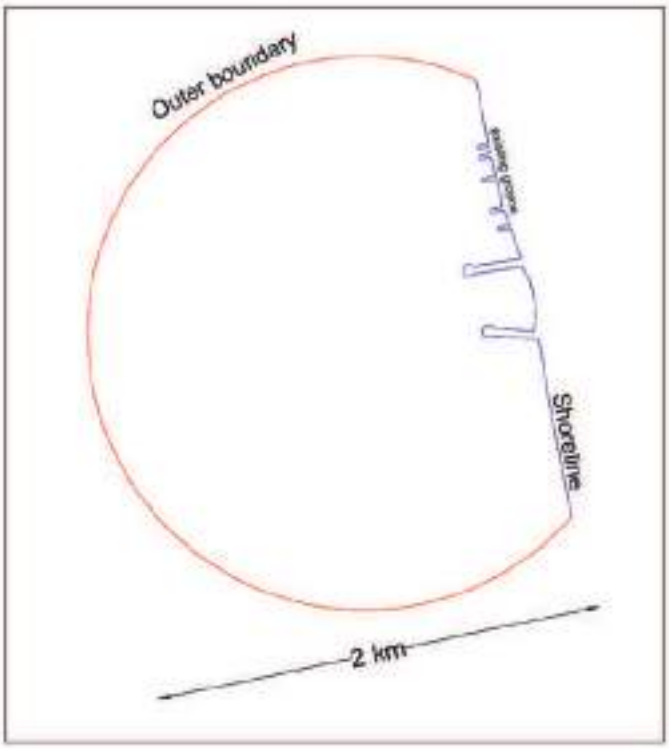


Fig.84 Computational domain

The outer semicircular periphery is modelled by 655 nodes with a spacing of 5m and the inner shoreline is modelled by nodes with a spacing of 5m. Then an unstructured mesh is created with an average spacing of 5m inside the domain. This leads to a total number of 72227 nodes with 143348 numbers of triangular elements. The mesh is shown in **Fig.85.**

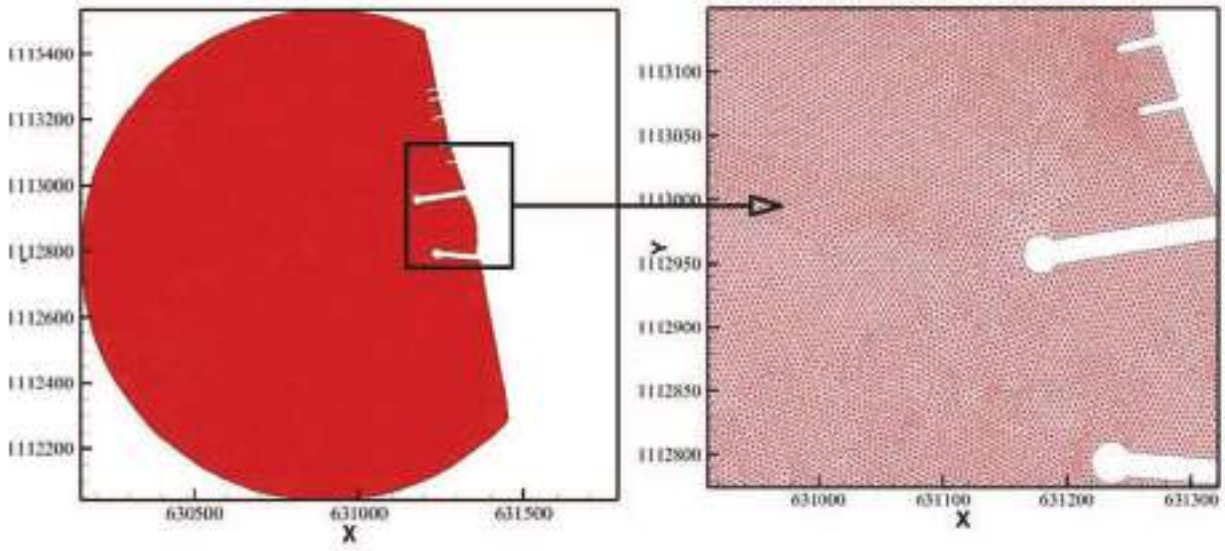


Fig.85 Mesh Structure adopted for the wave propagation modelling

12.7.2 Result for Puthenkadappuram

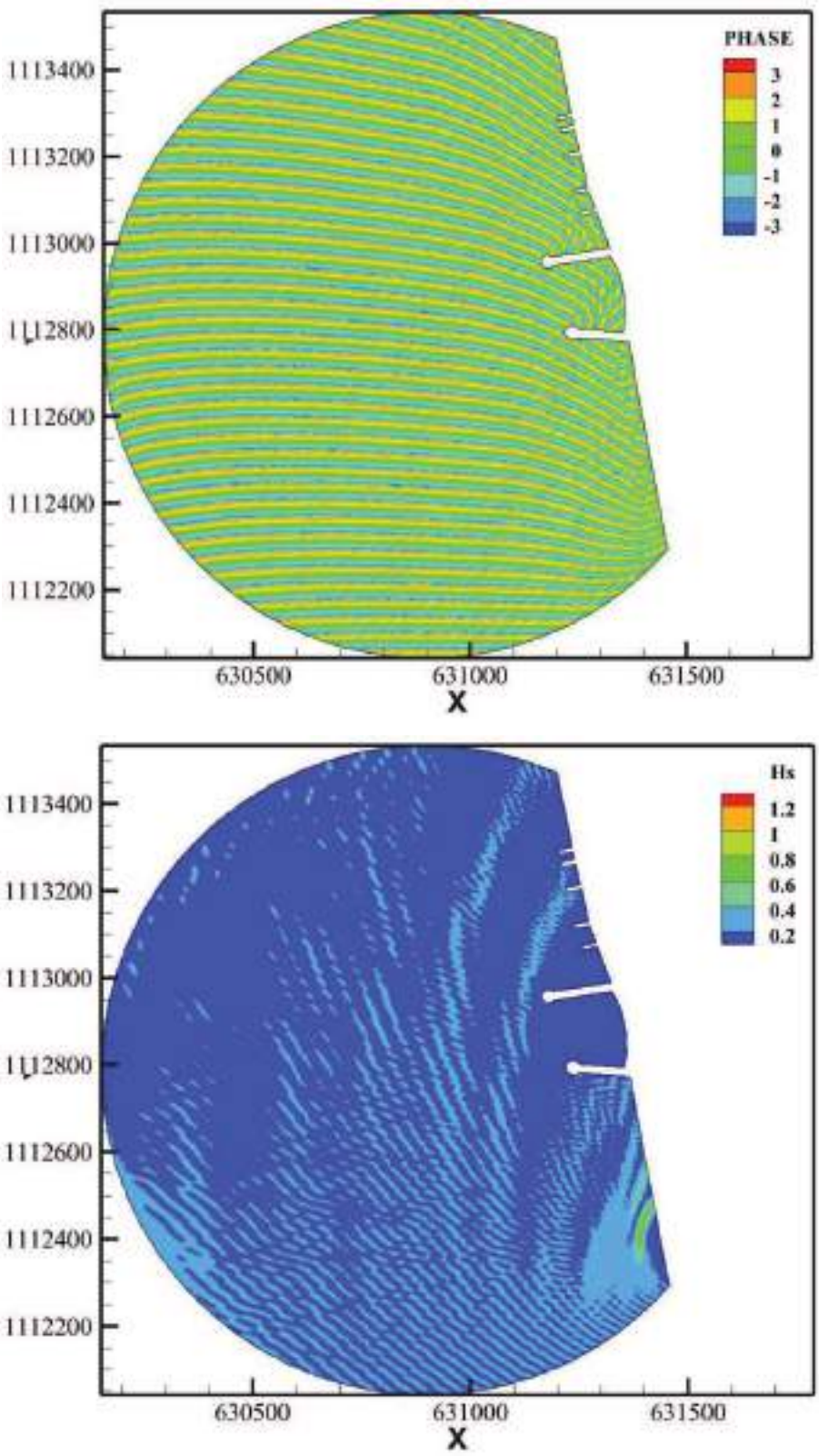


Fig.86a Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 180^0

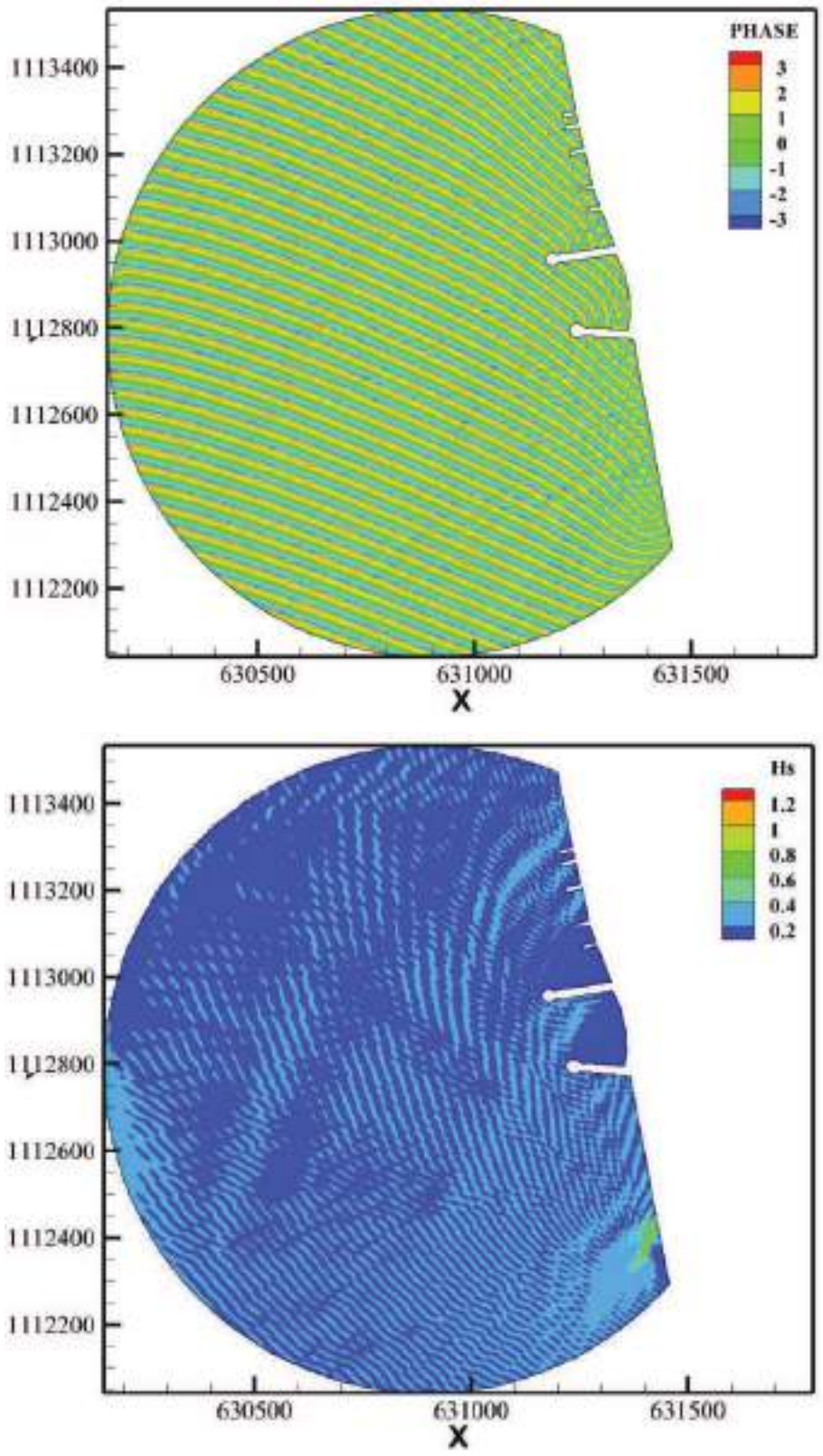


Fig.86b Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 200^0

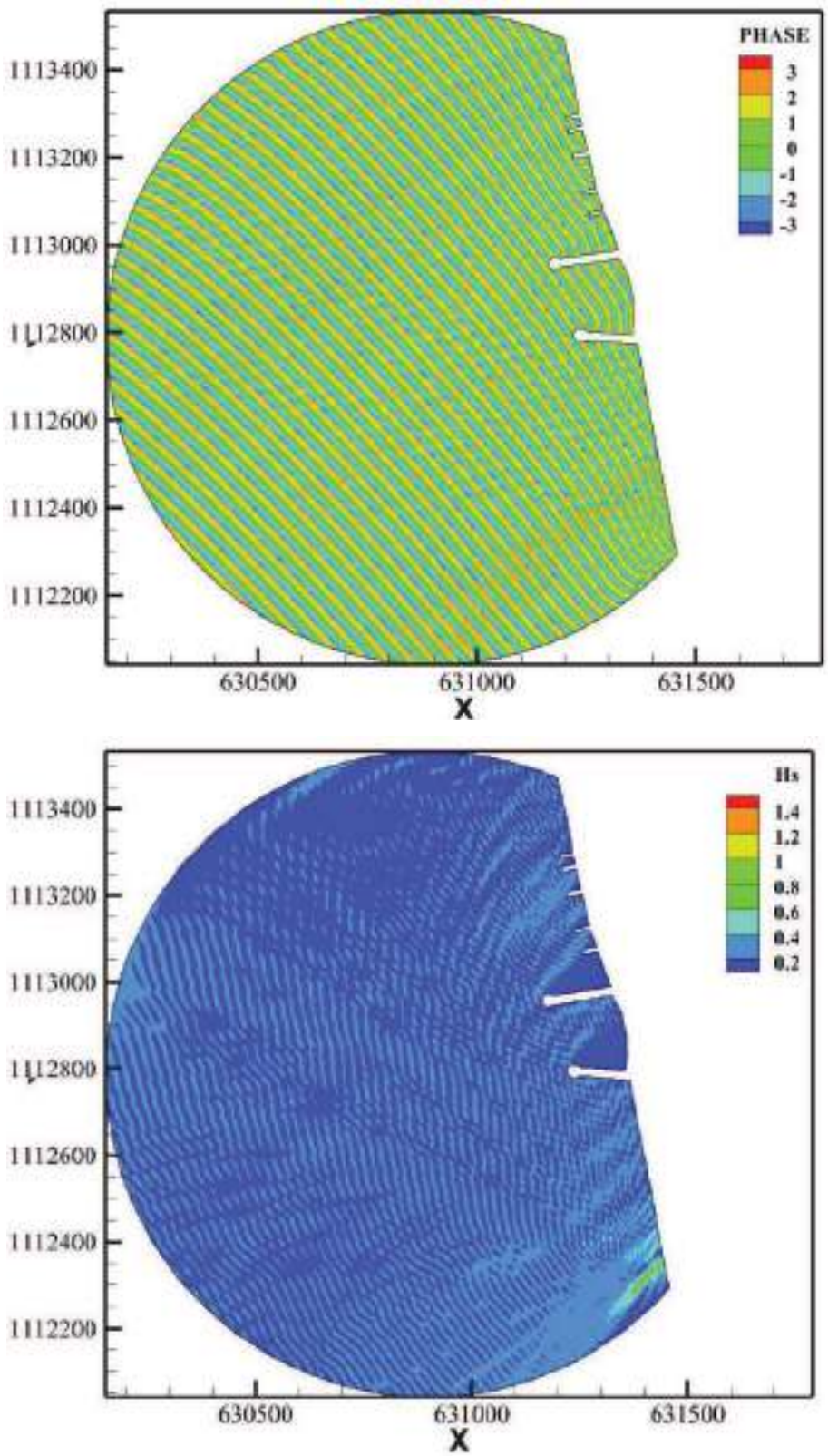


Fig.86c Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 225^0

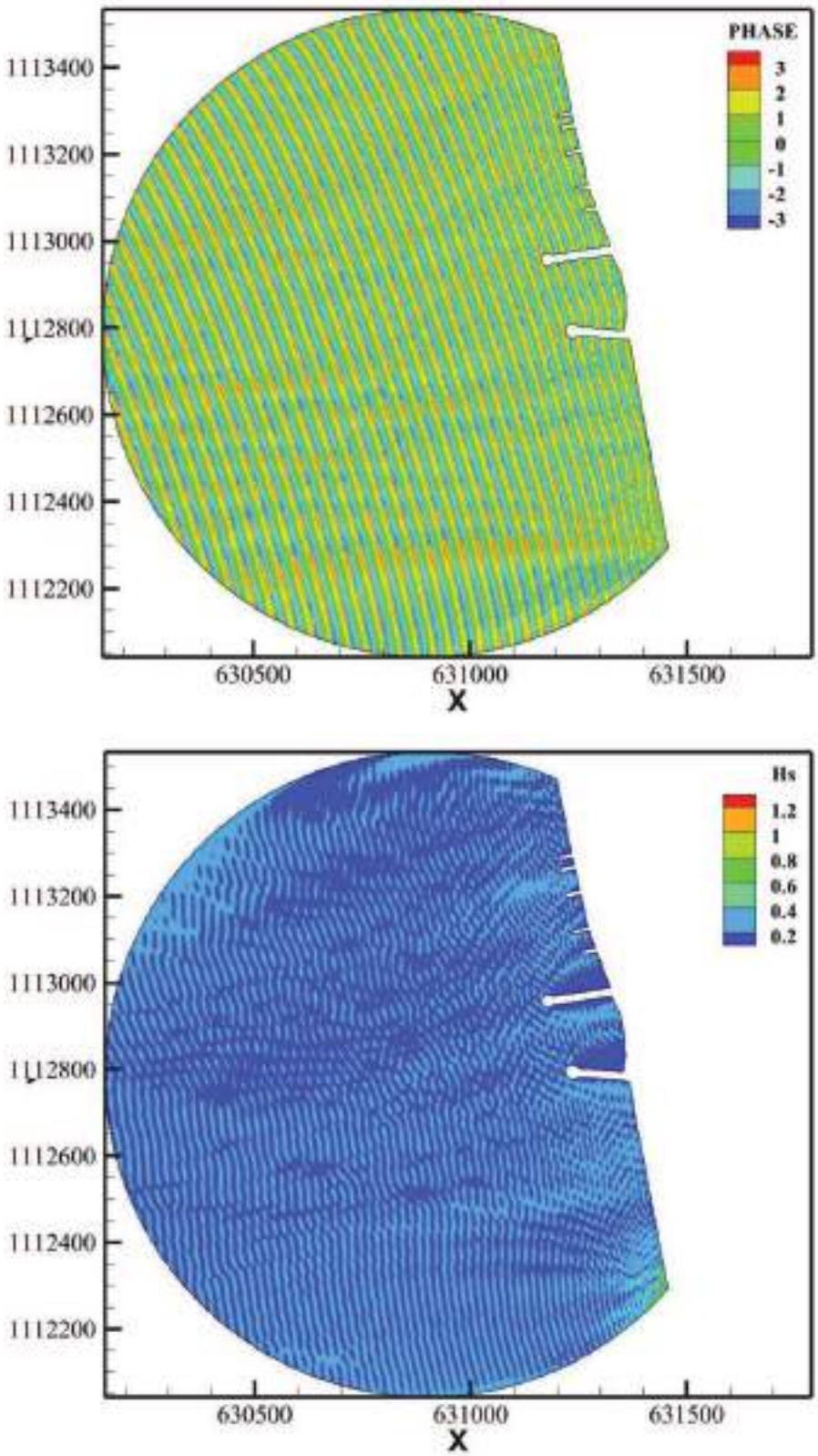


Fig.86d Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 250^0

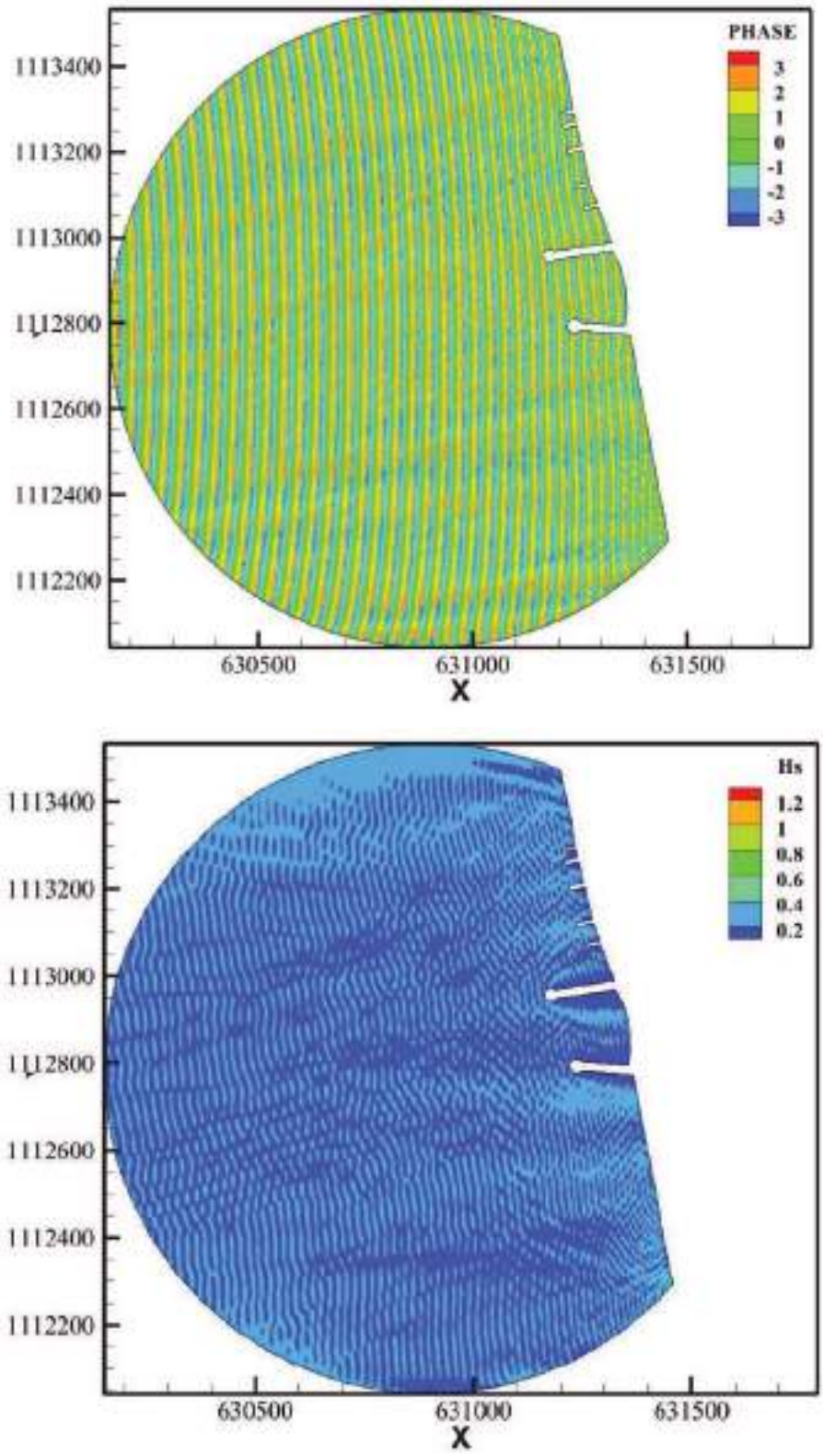


Fig.86e Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 270^0

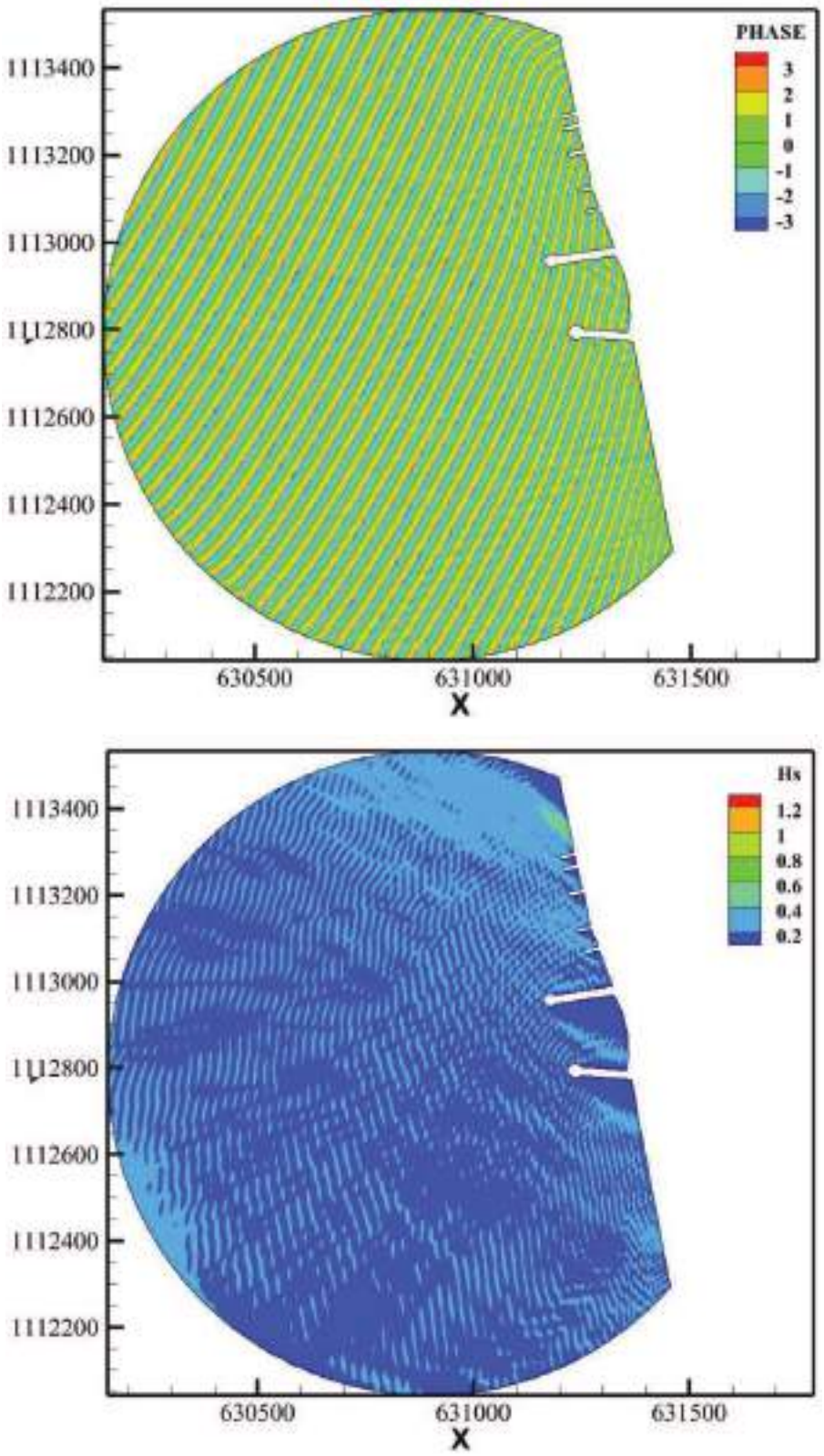


Fig.86f Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 300^0

12.8 Pazhangadu

Client: (KSCADC) & GIDA, KERALA

The study aims at providing an in-depth analysis on the wave characteristics along the Groyne field at Pazhangadu.

12.8.1 Computational domain

The computational domain roughly approximates a semi-circle of radius 1.5 km. **Fig.87** shows the domain where the computations are performed. The direction of the incident monochromatic wave is defined with respect to the geometric northern direction.

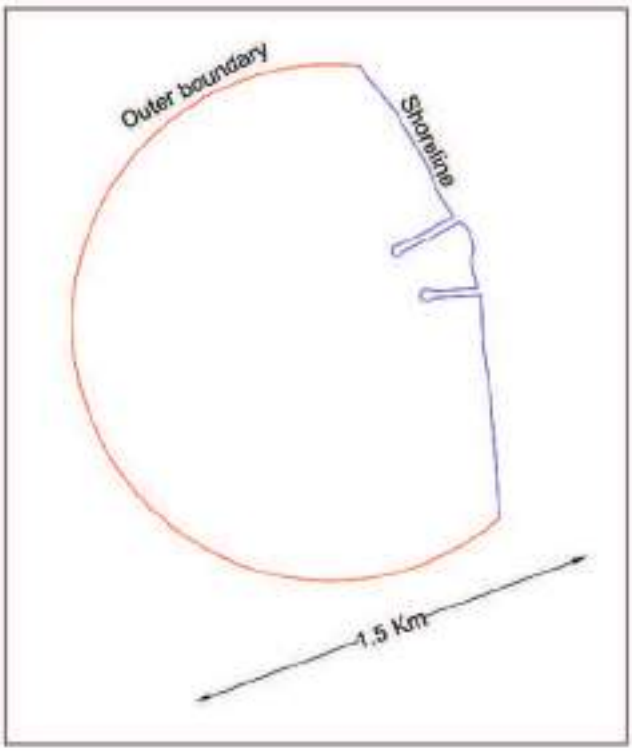


Fig.87 Computational domain

The outer semicircular periphery is modelled by 547 nodes with a spacing of 5m and the inner shoreline is modelled by nodes with a spacing of 5m. Then an unstructured mesh is created with an average spacing of 5m inside the domain. This leads to a total number of 55862 nodes with 110774 numbers of triangular elements. The mesh is shown in **Fig. 88.**

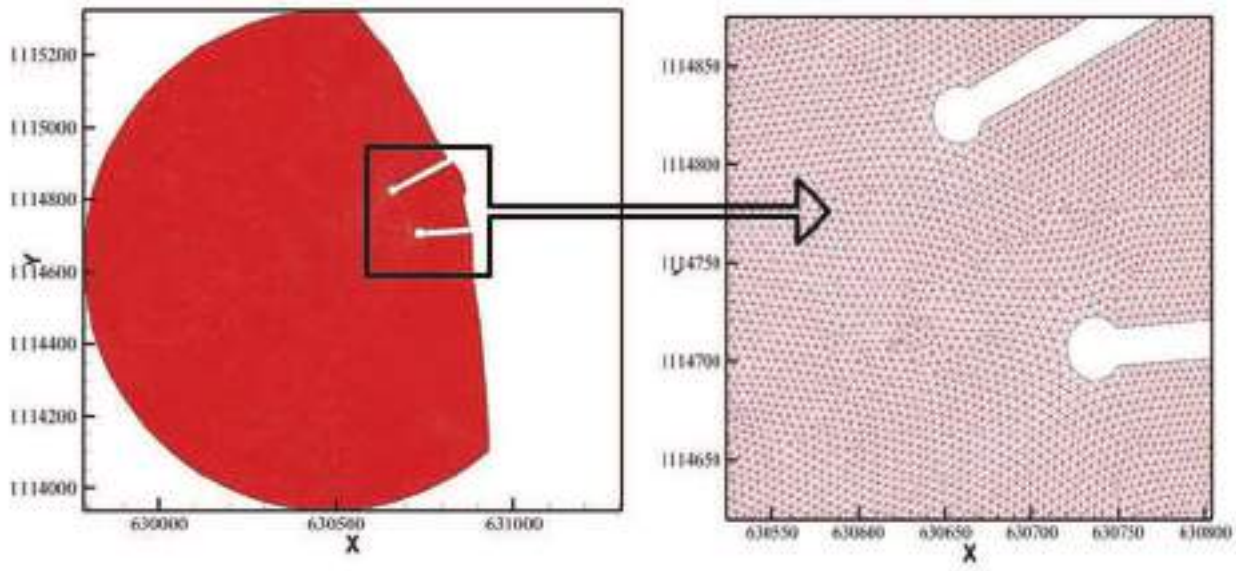
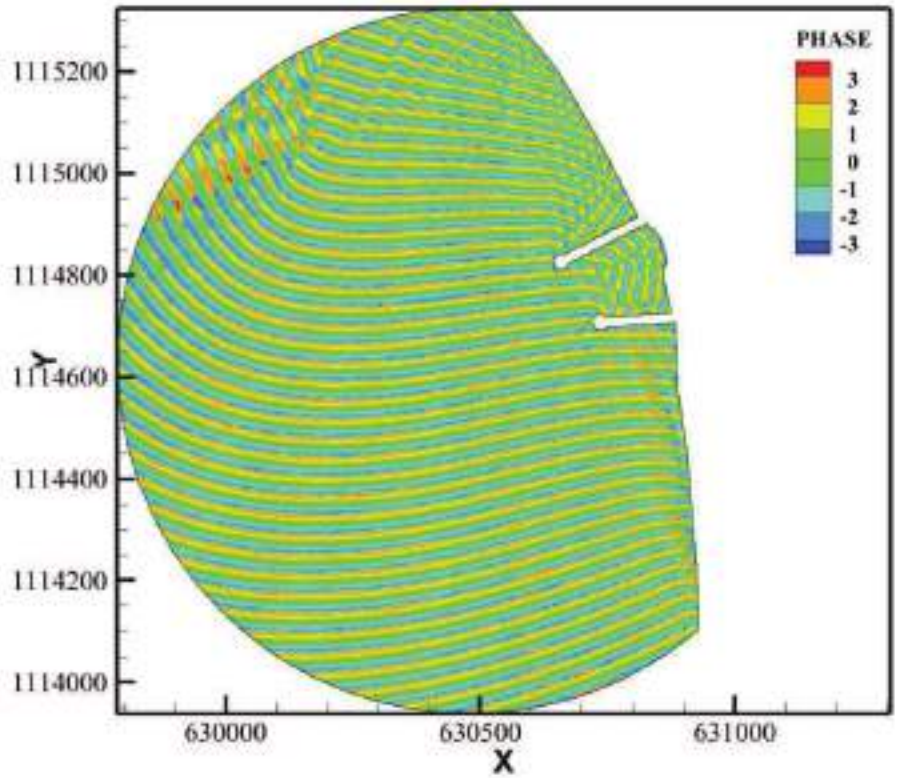


Fig.88 Mesh Structure adopted for the wave propagation modeling

12.8.1 Results and discussion for Pazhangadu



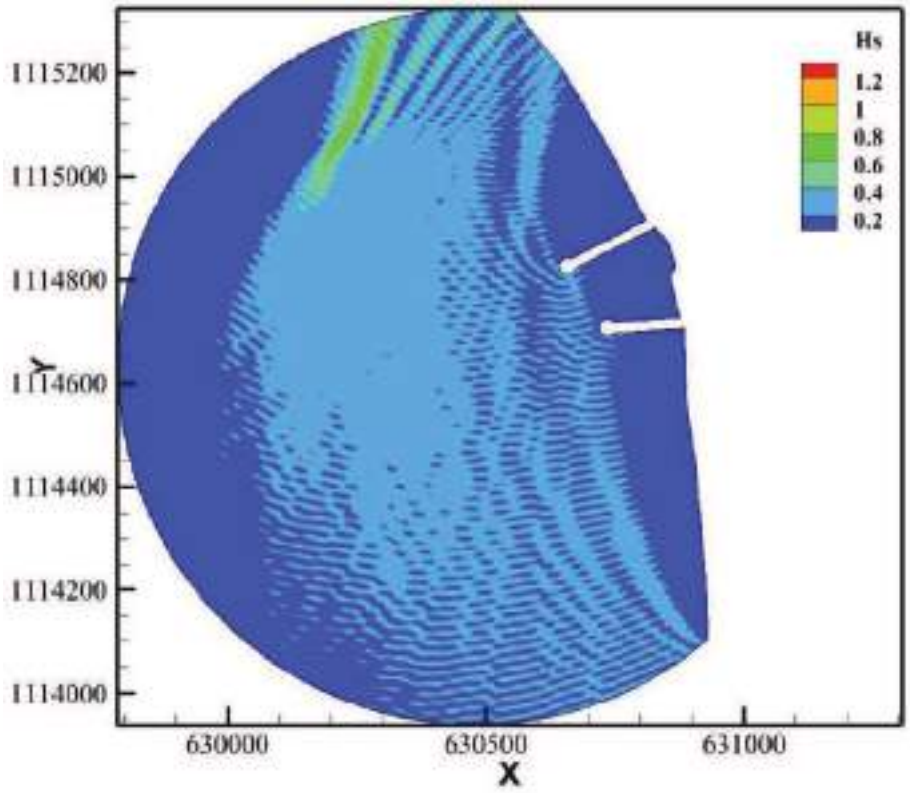
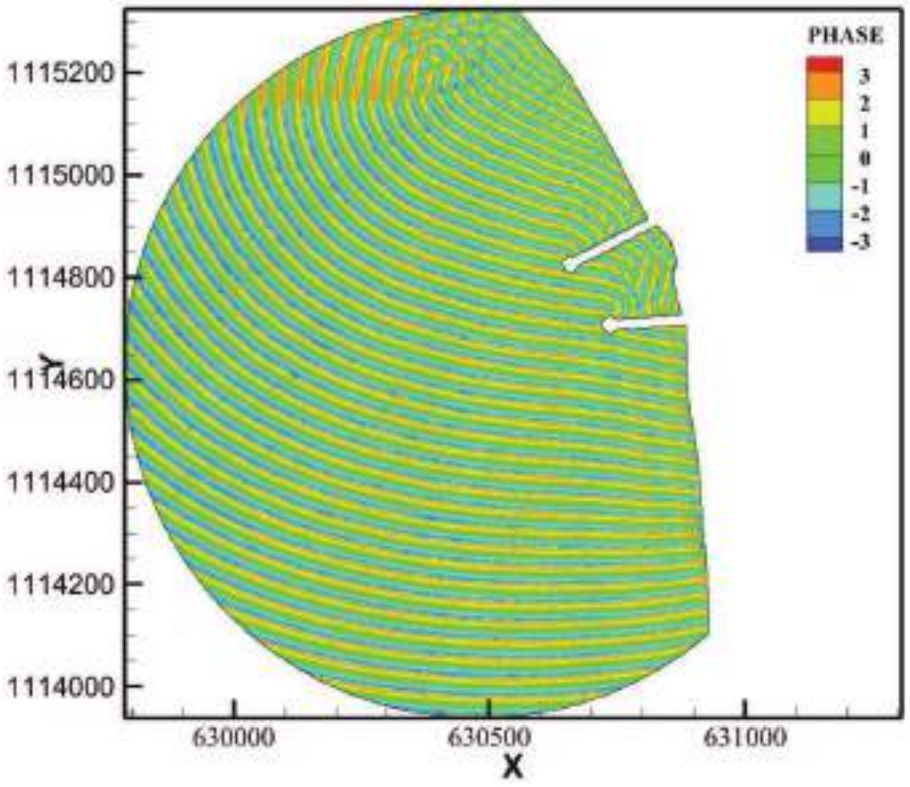


Fig.89a Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 180^0



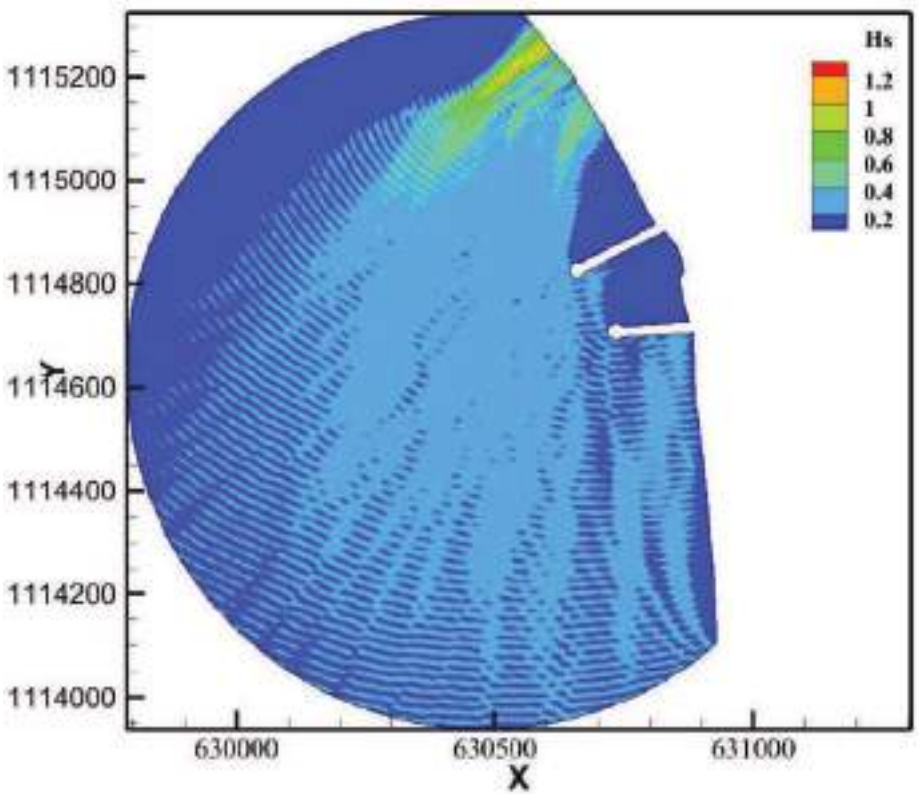
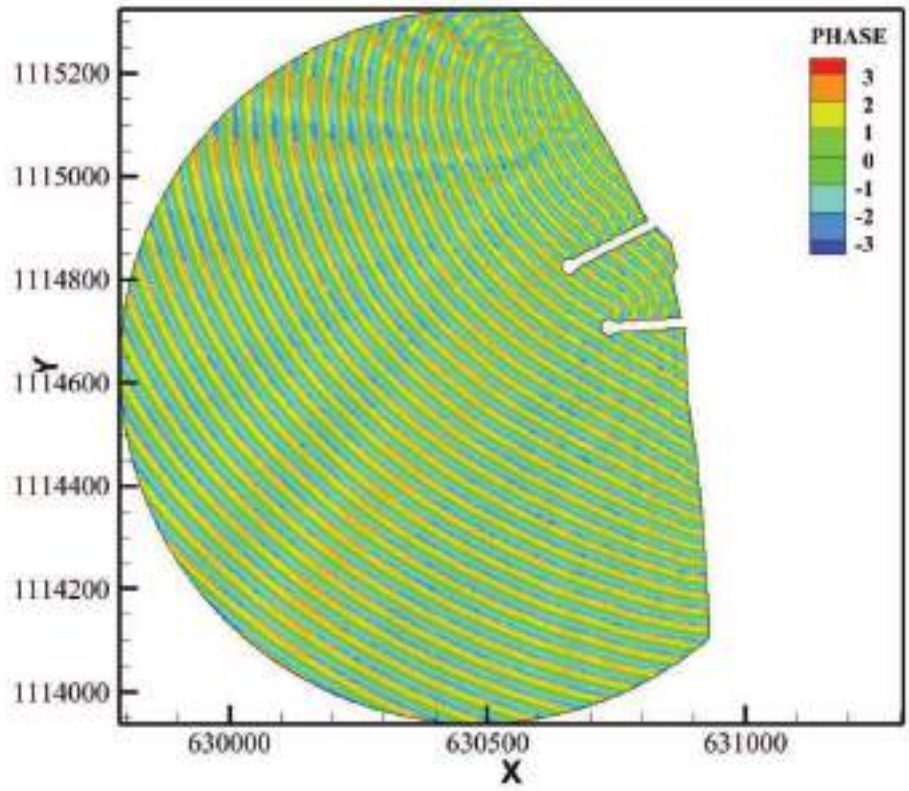


Fig.89b Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 200^0



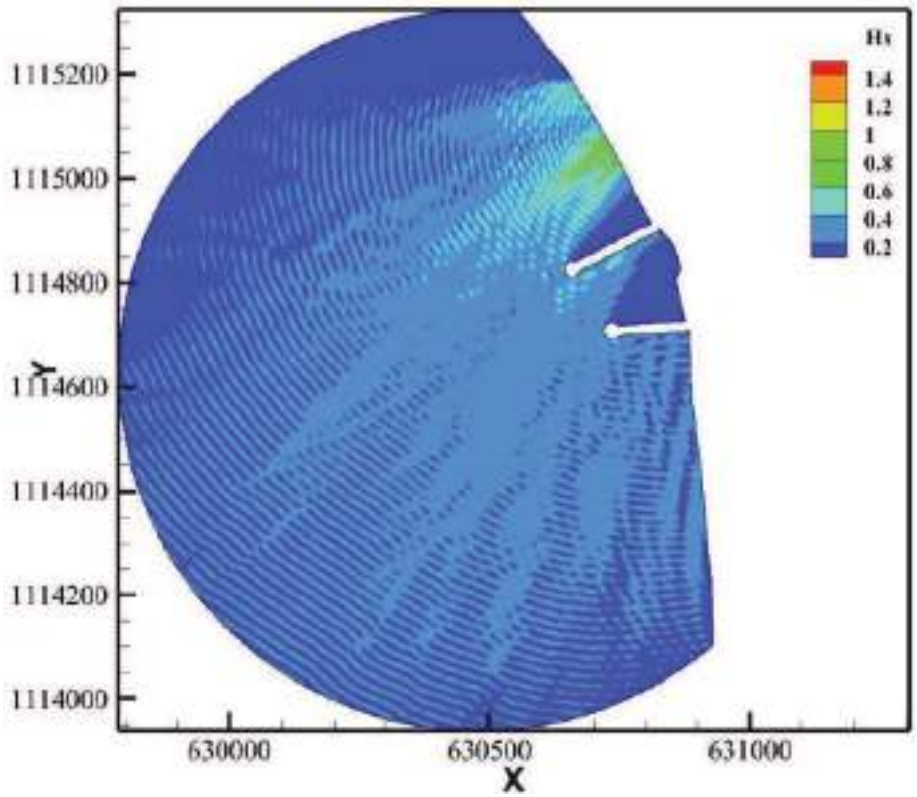
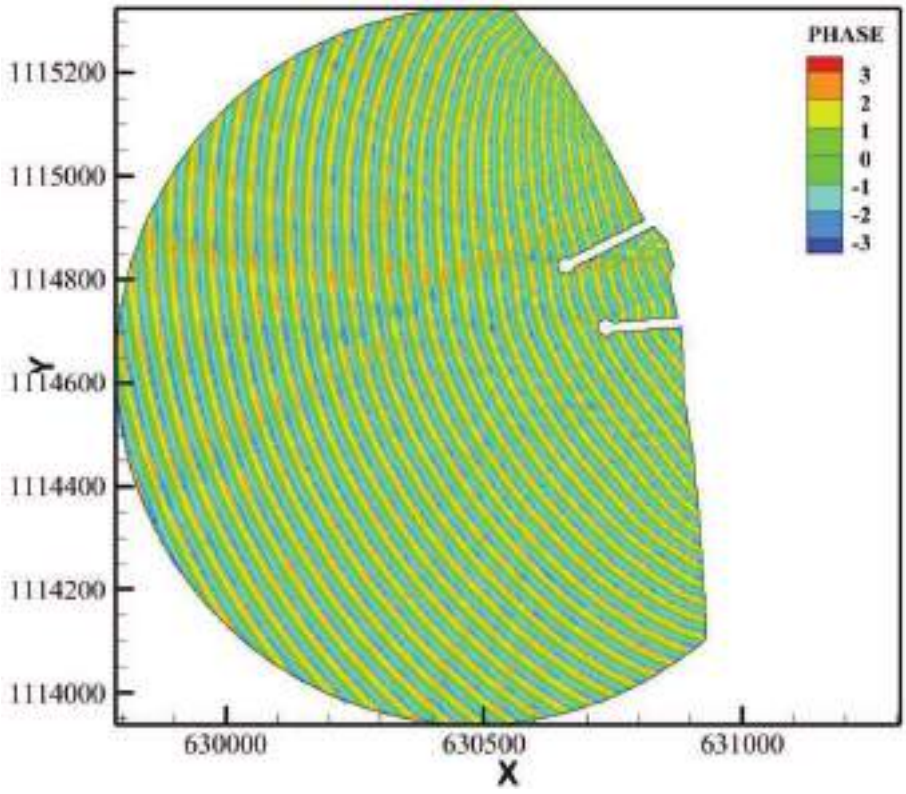


Fig.89c Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 225^0



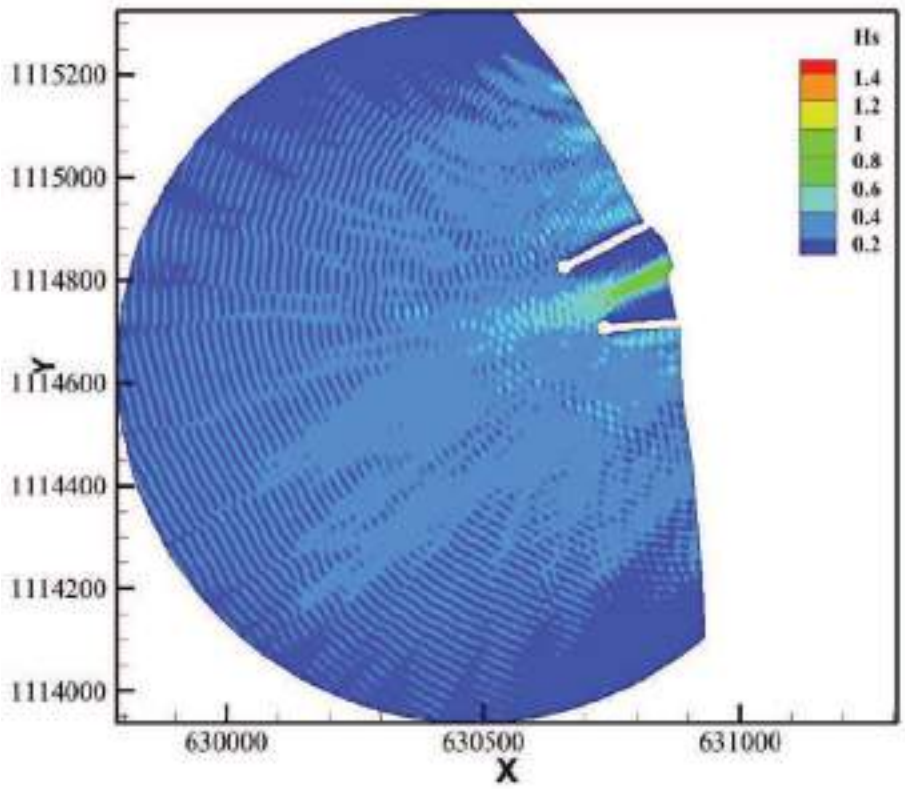
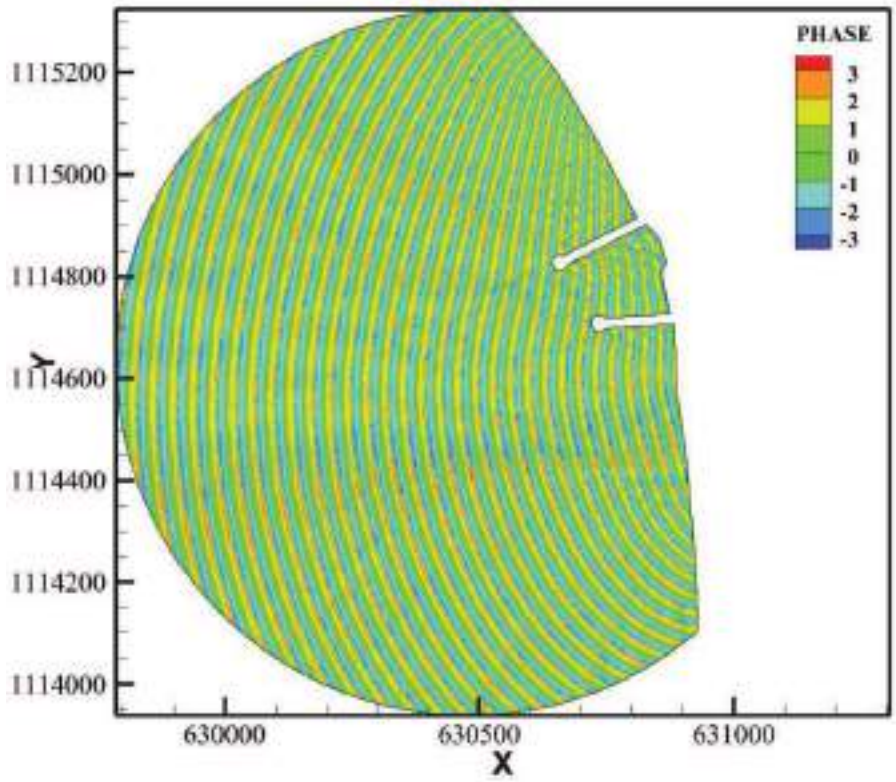


Fig.89d Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 250^0



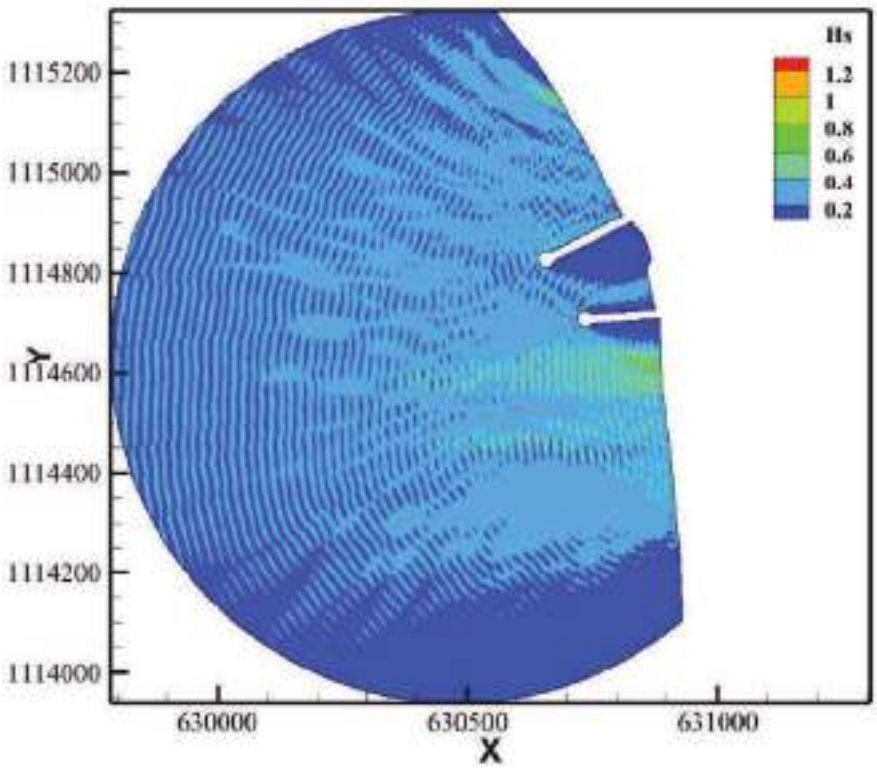
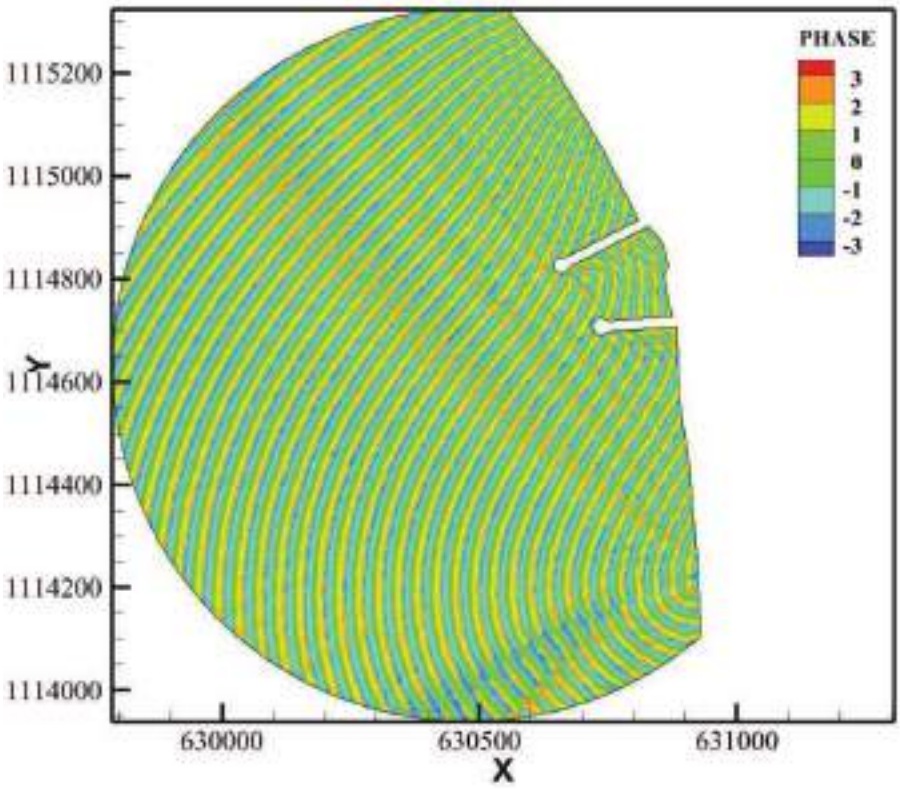


Fig.89e Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 270^0



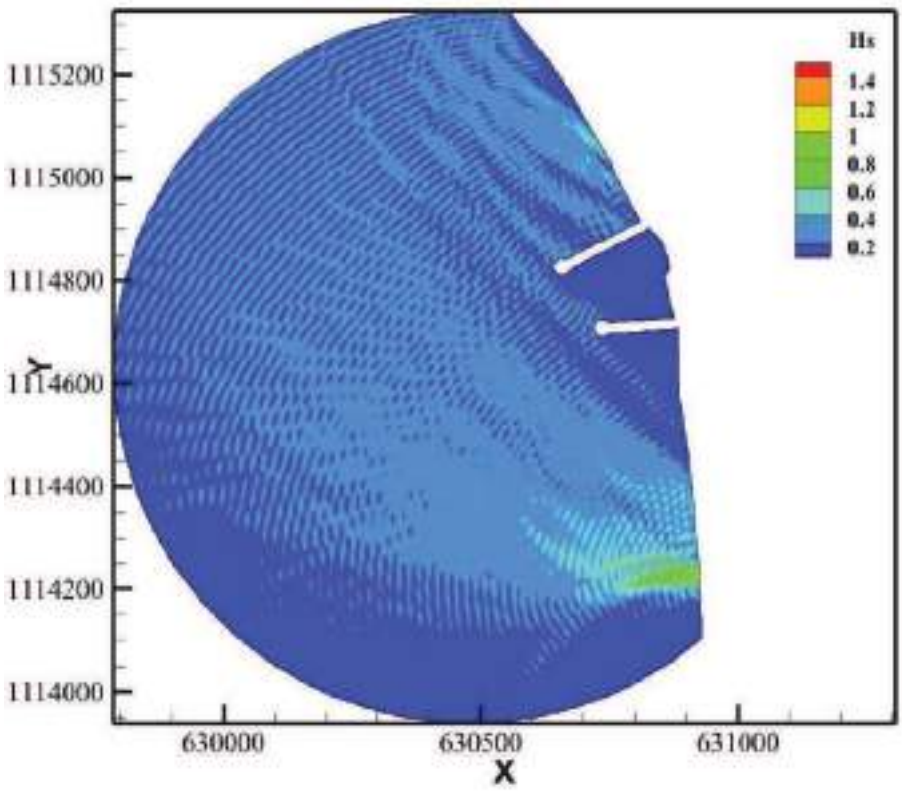


Fig.89f Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 300^0

12.9 Saidh Mohammed Beach

The study aims at providing an in-depth analysis on the wave characteristics along the Groyne field at Saidh Mohammed beach **.**

12.9.1 Computational domain

The computational domain roughly approximates a semi-circle of radius 1.5 km. **Fig.90** shows the domain where the computations are performed. The direction of the incident monochromatic wave is defined with respect to the geometric northern direction.

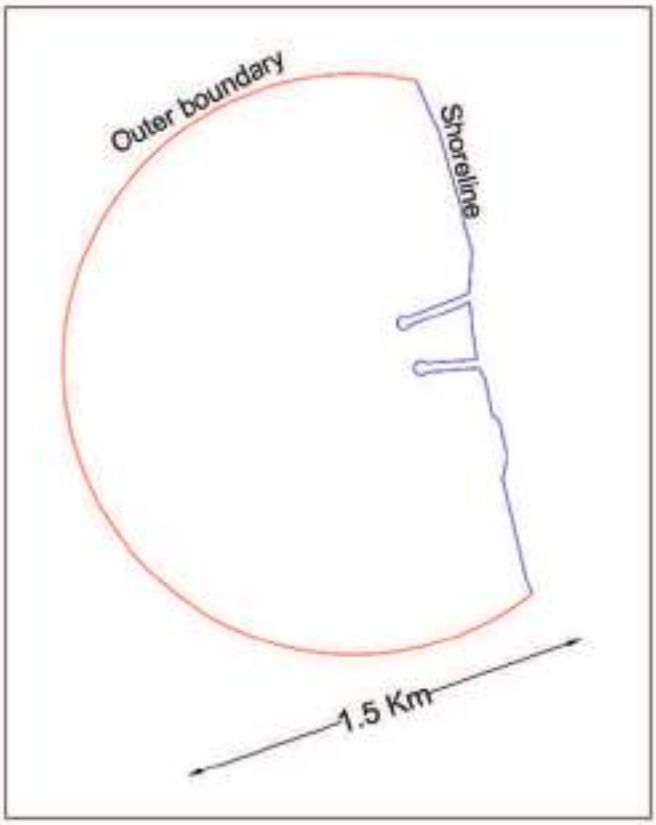


Fig.90 Computational domain

The outer semicircular periphery is modeled by 527 nodes with a spacing of 5m and the inner shoreline is modeled by nodes with a spacing of 5m. Then an unstructured mesh is created with an average spacing of 5m inside the domain. This leads to a total number of 48316 nodes with 95732 numbers of triangular elements. The mesh is shown in **Fig. 91.**

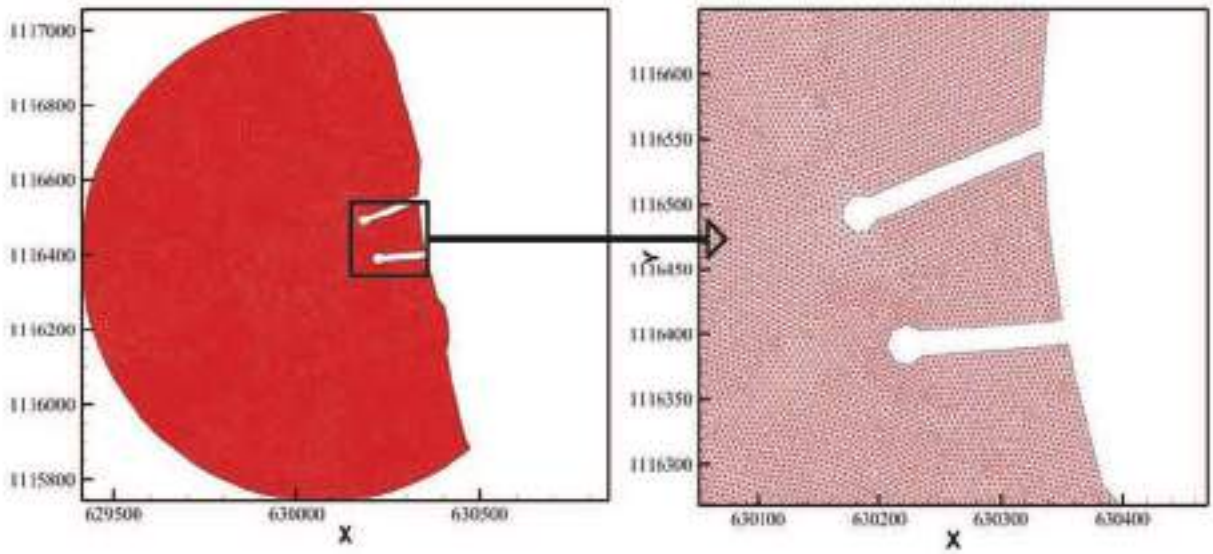


Fig.91 Mesh Structure adopted for the wave propagation modelling

12.9.2 Result for Saidh Mohammed beach

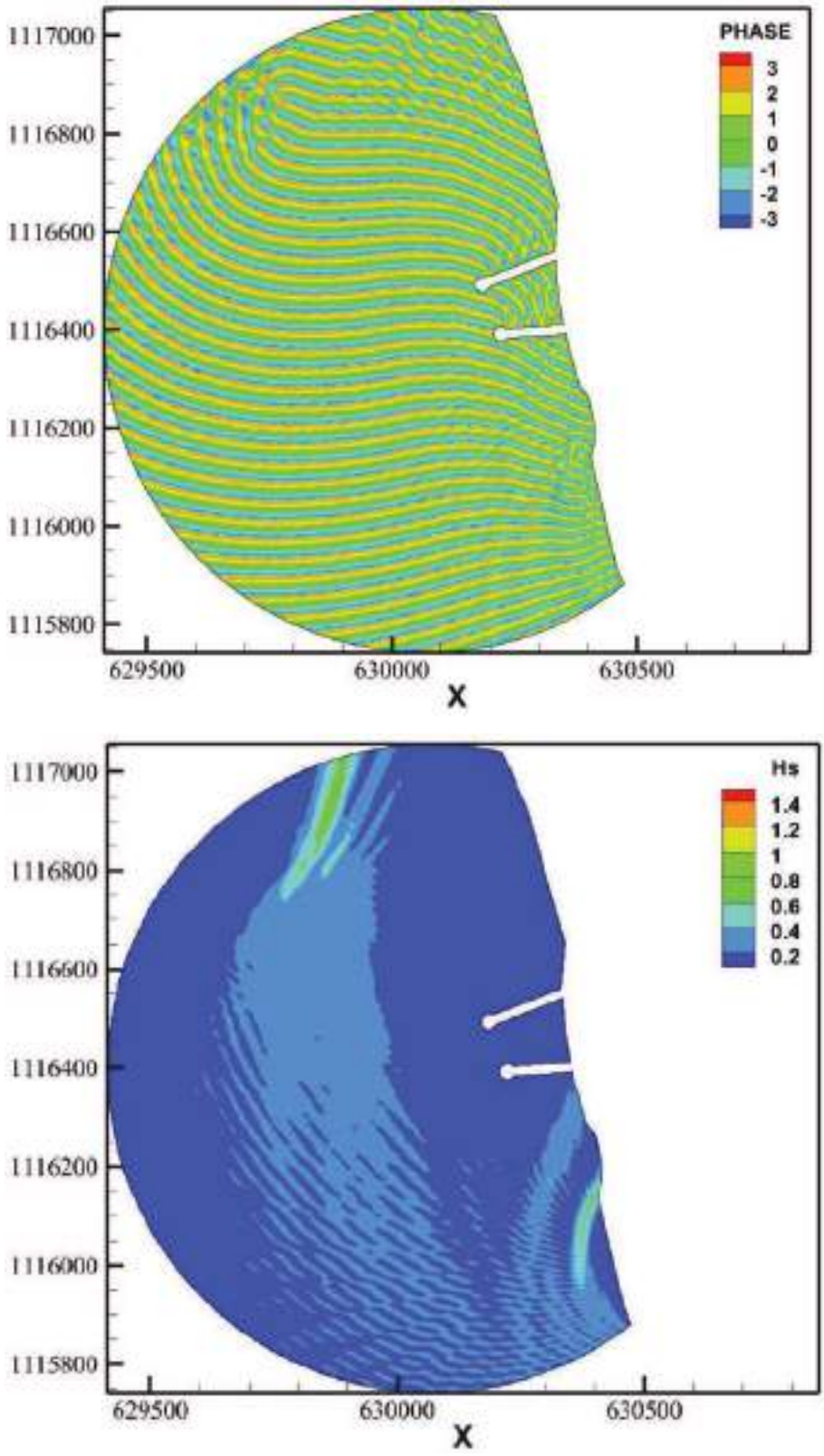


Fig.92a Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 180^0

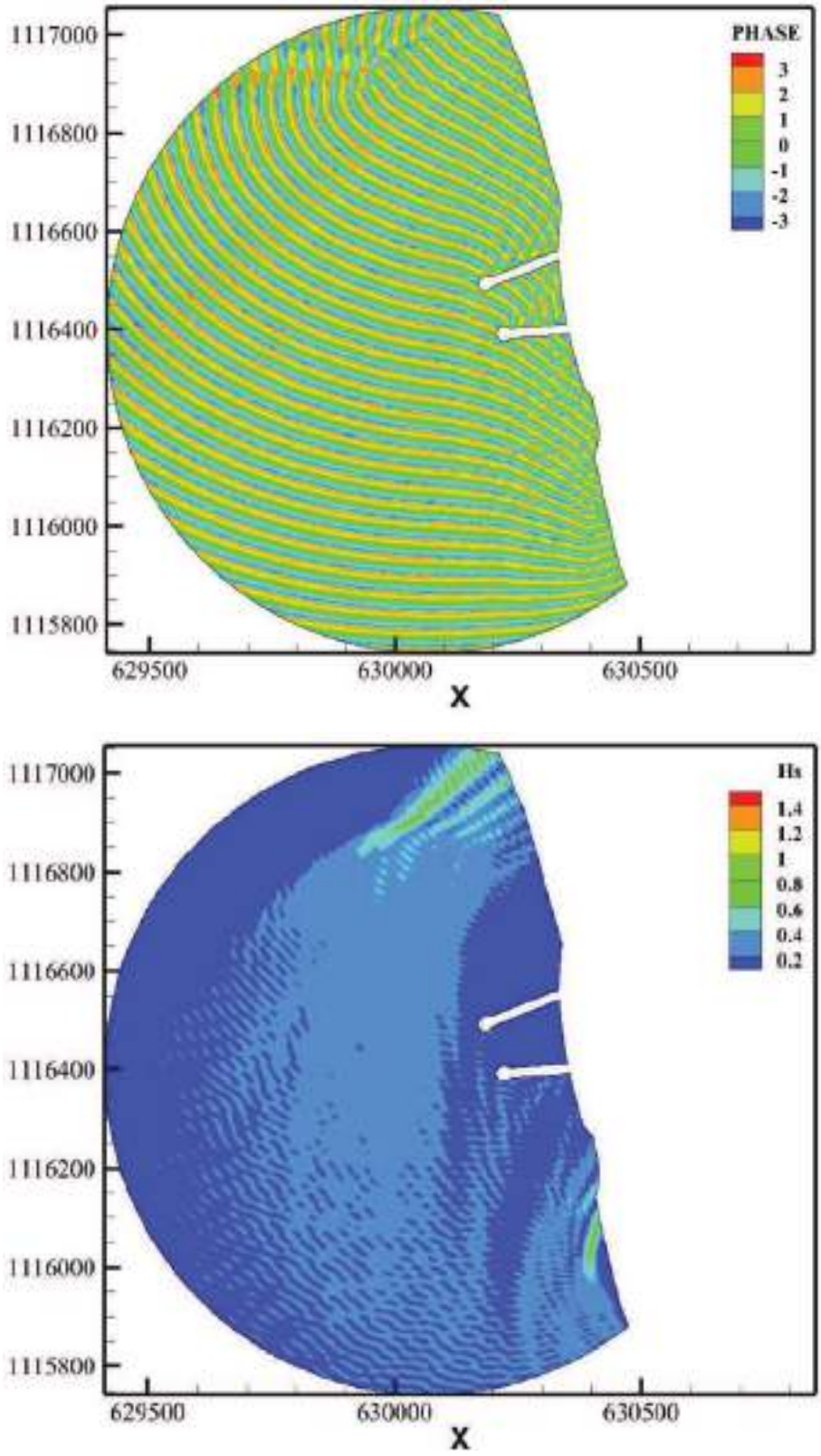


Fig. 92b Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 200^0

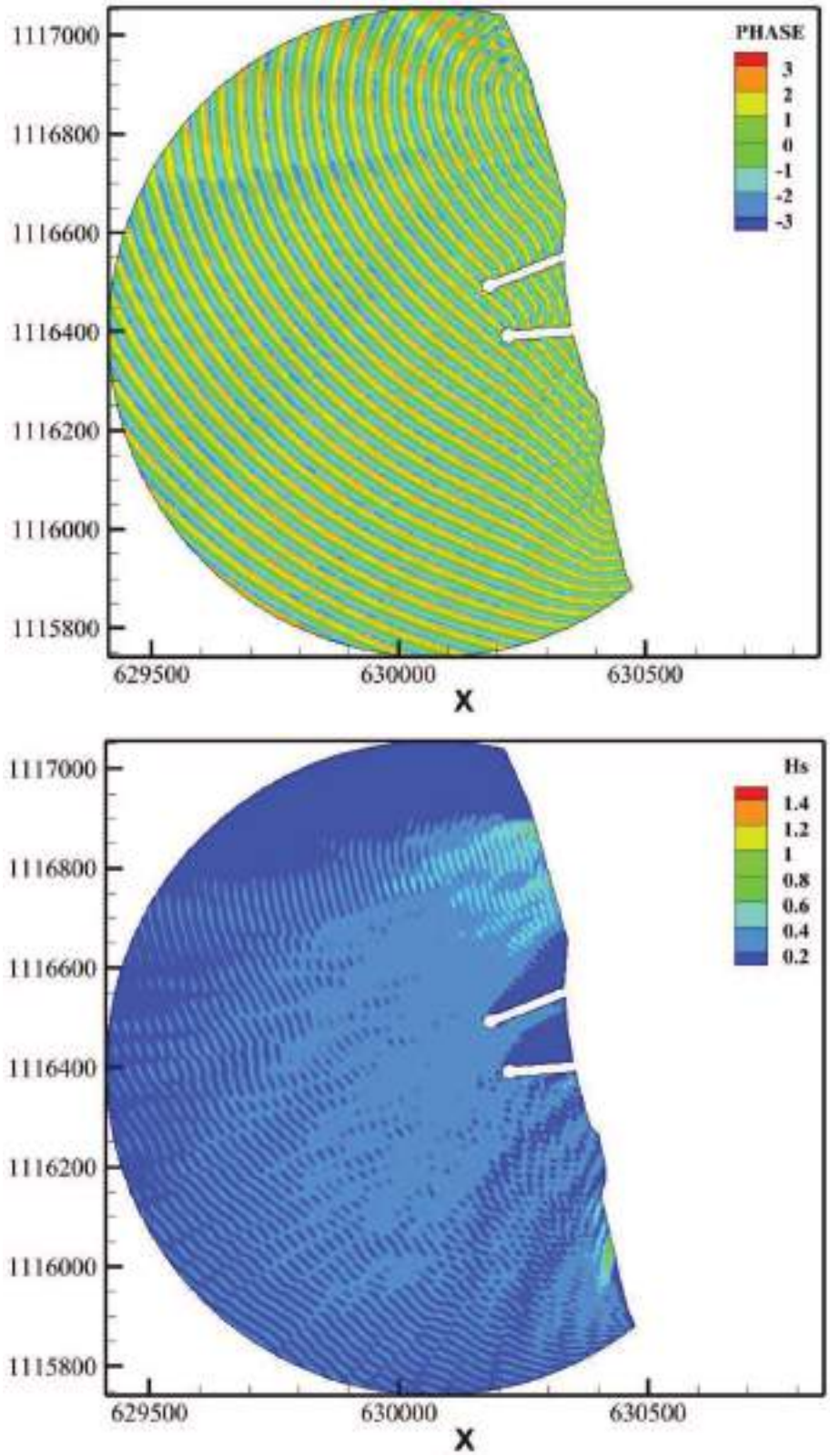


Fig.92c Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 225^0

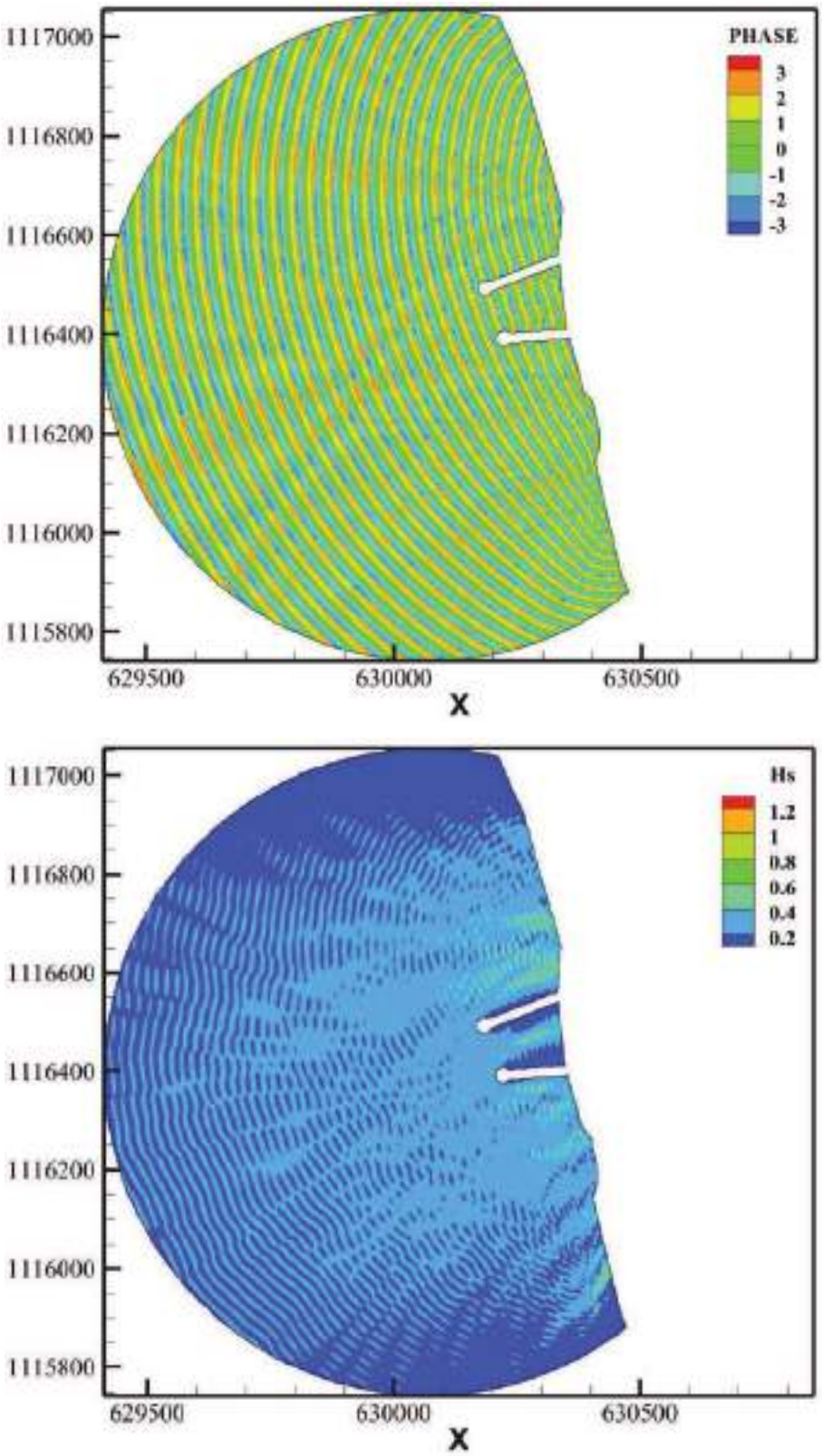


Fig.92d Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 250^0

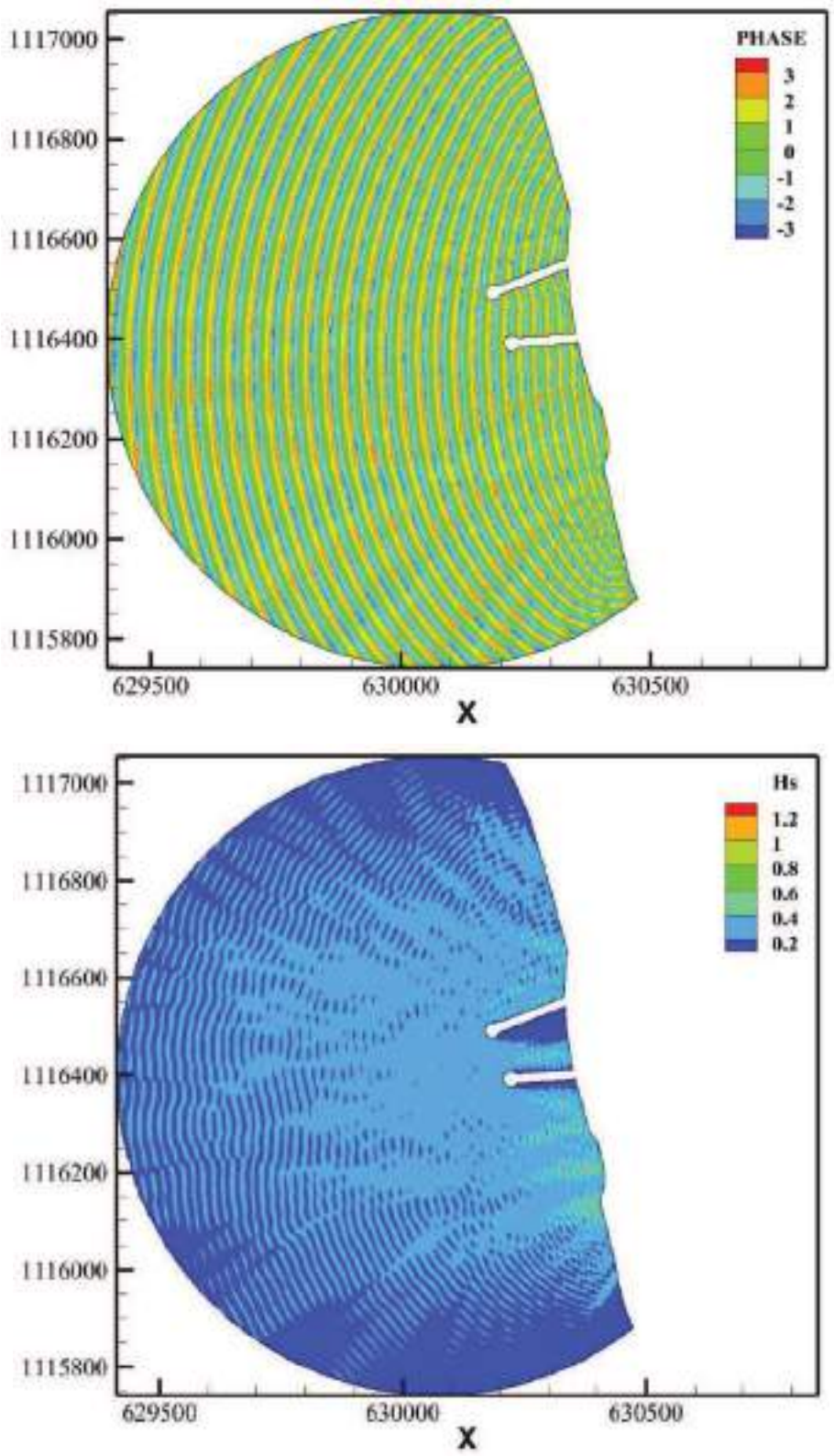


Fig.92e Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 270^0

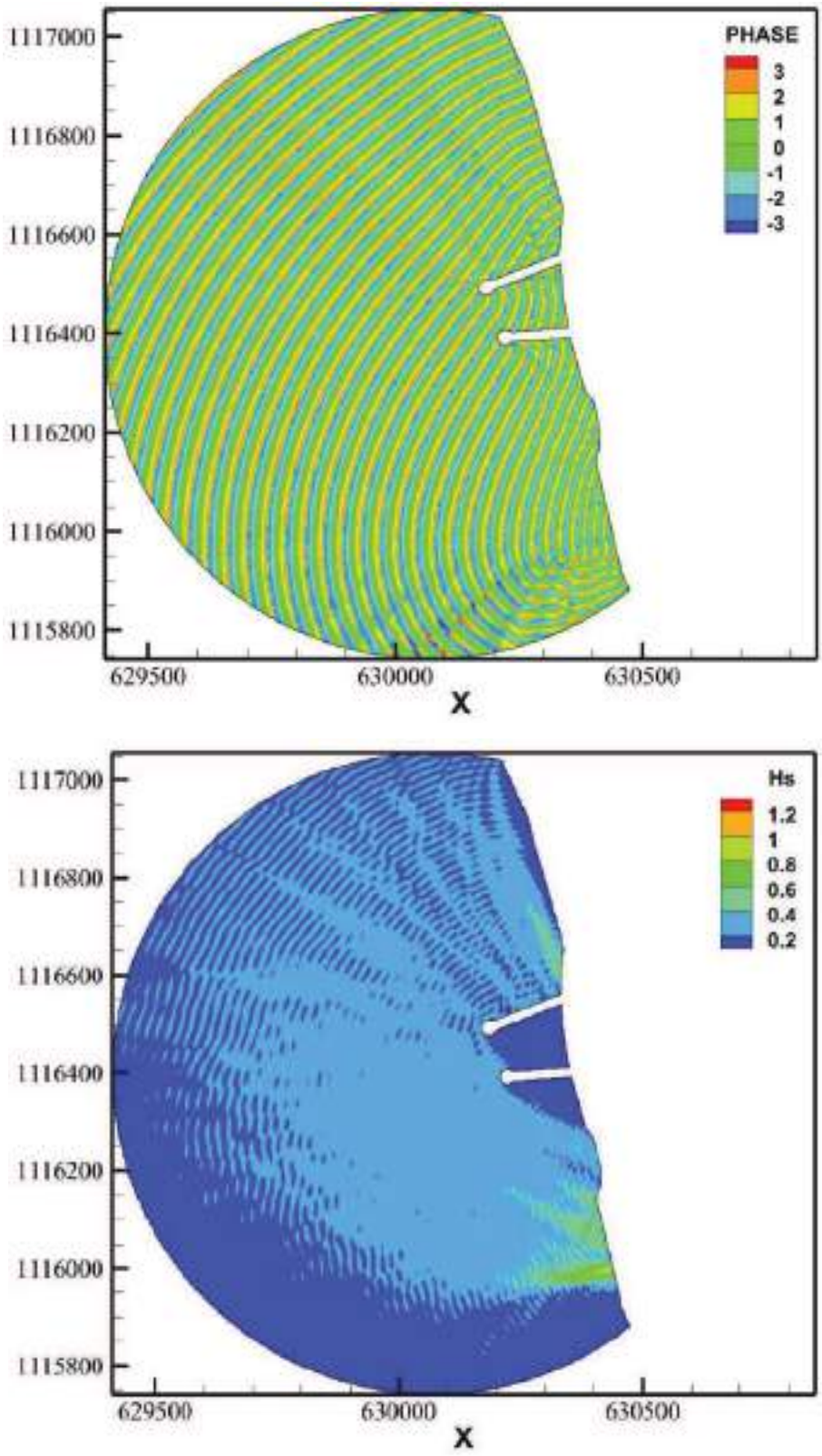


Fig.92f Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 300^0

12.10 Saidh Mohammed Beach 2 To Cherai Beach (Phase 1)

Client: (KSCADC) & GIDA, KERALA

The study aims at providing an in-depth analysis on the wave characteristics for series of groynes along the Saidh Mohammed beach 2 to Cherai Beach.

12.10.1 Computational domain

The computational domain roughly approximates a semi-circle of radius 4.5 km. **Fig.93** shows the domain where the computations are performed. The direction of the incident monochromatic wave is defined with respect to the geometric northern direction.

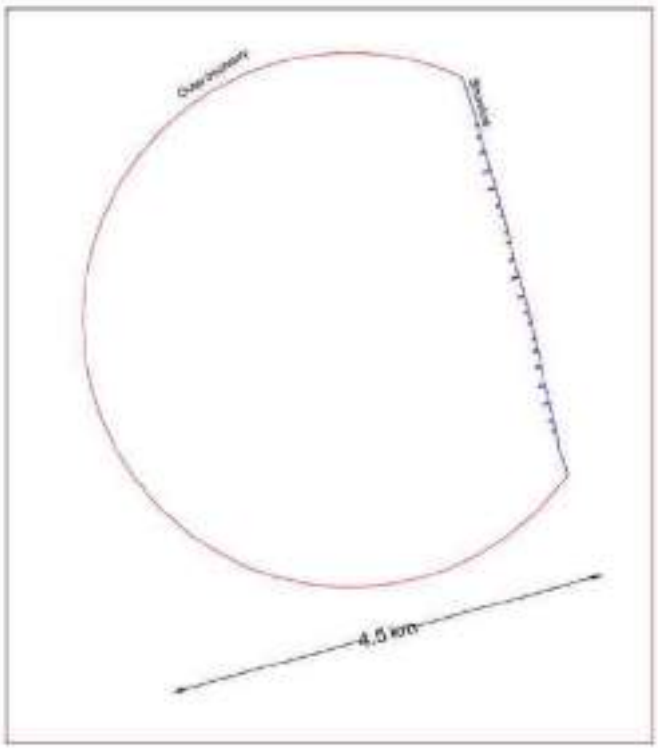


Fig.93 Computational domain

The outer semicircular periphery is modeled by 860 nodes with a spacing of 5m and the inner shoreline is modeled by nodes with a spacing of 5m. Then an unstructured mesh is created with an average spacing of 5m inside the domain. This leads to a total number of 133533 nodes with 265692 numbers of triangular elements. The mesh is shown in **Fig. 94.**

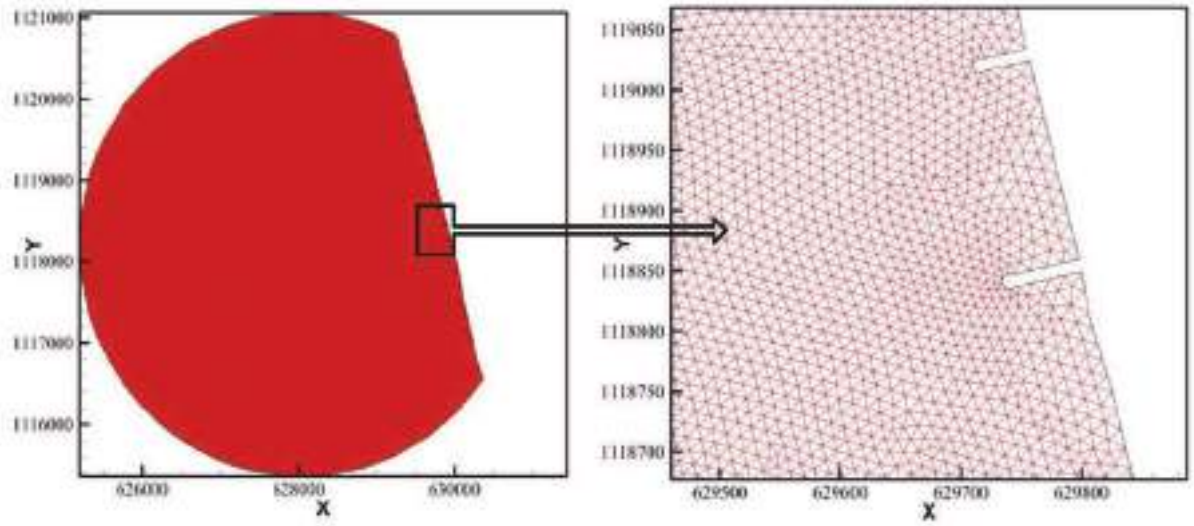
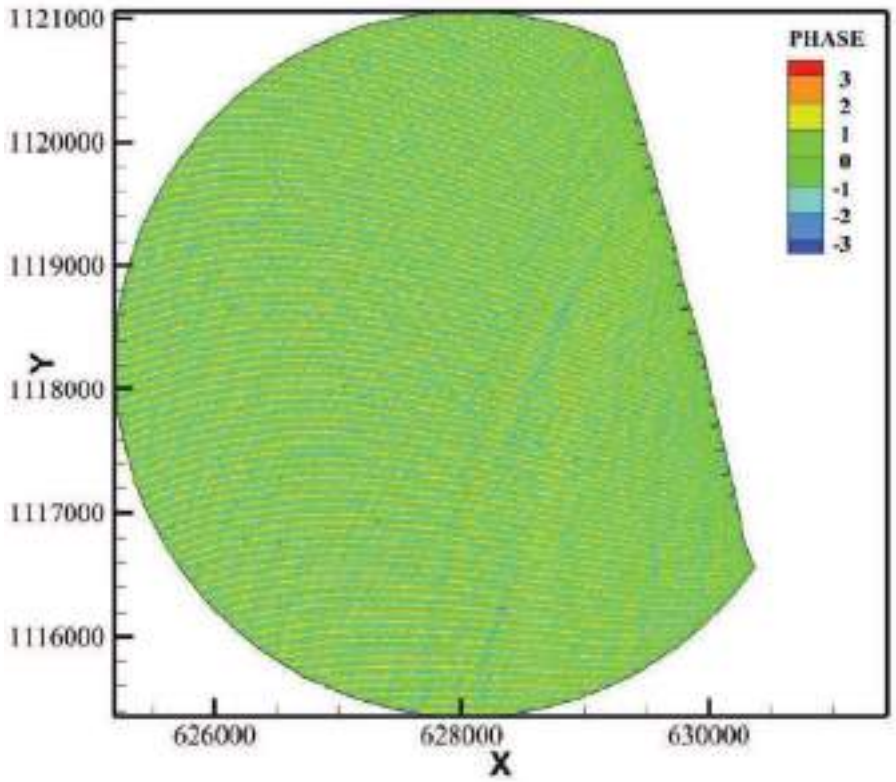


Fig.94 Mesh Structure adopted for the wave propagation modelling

12.10.2 Results for Saidh Mohammed Beach 2 To Cherai Beach (Phase 1)



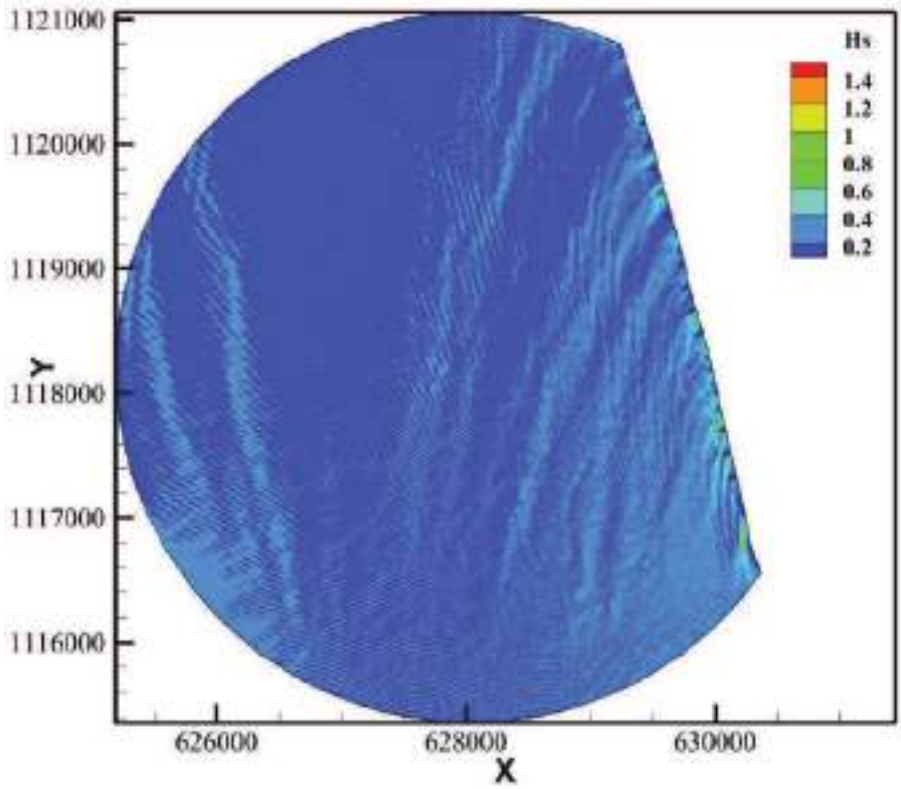
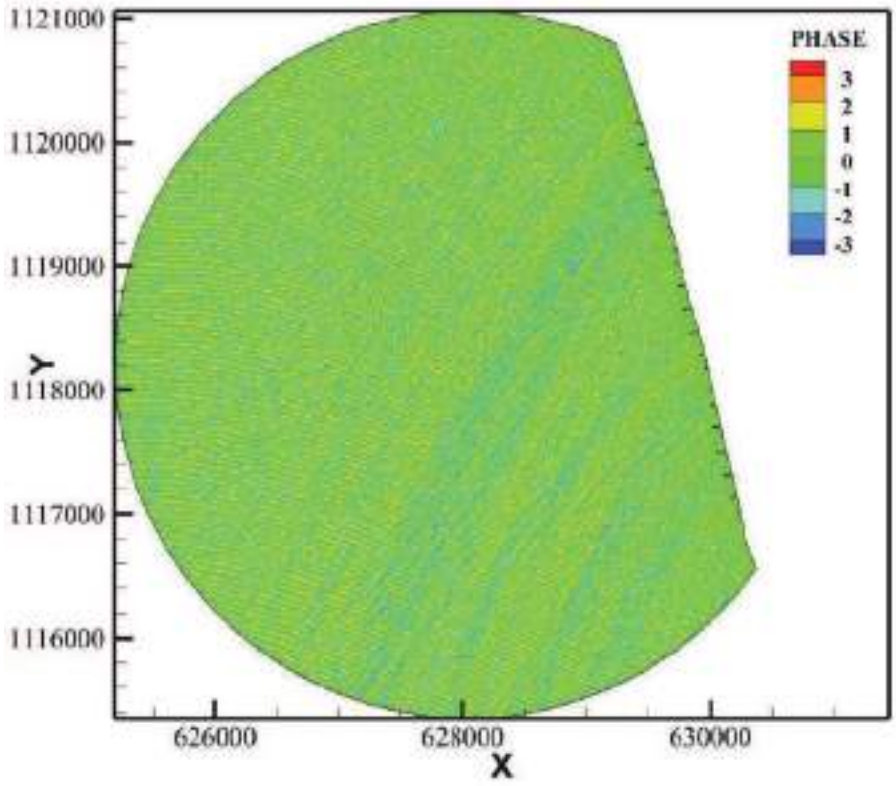


Fig.95a Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 180^0



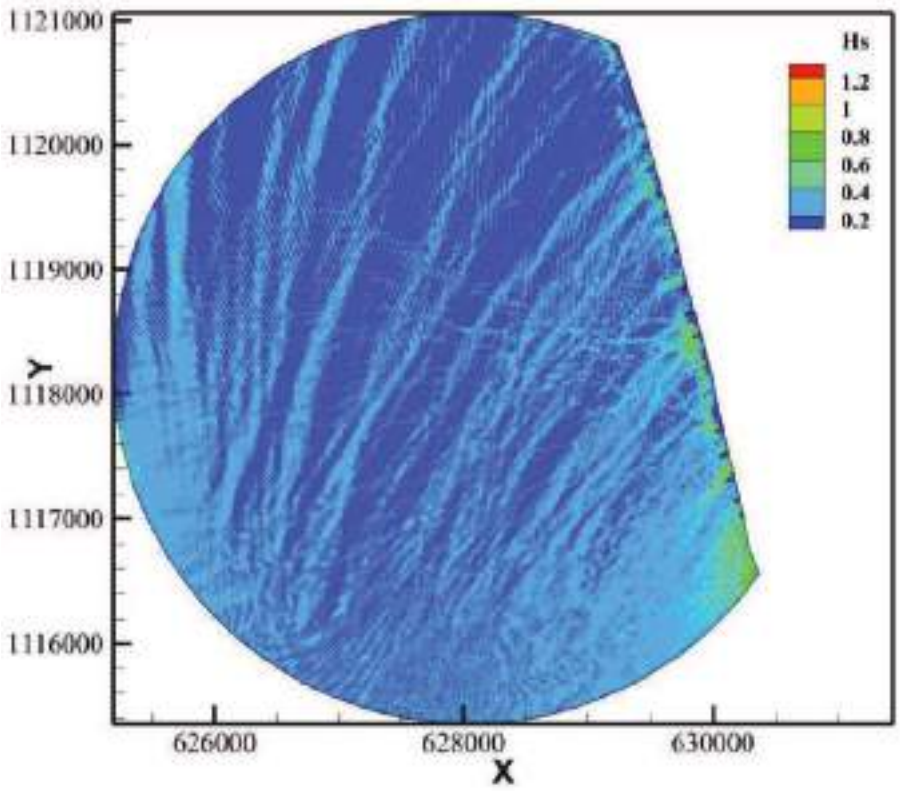
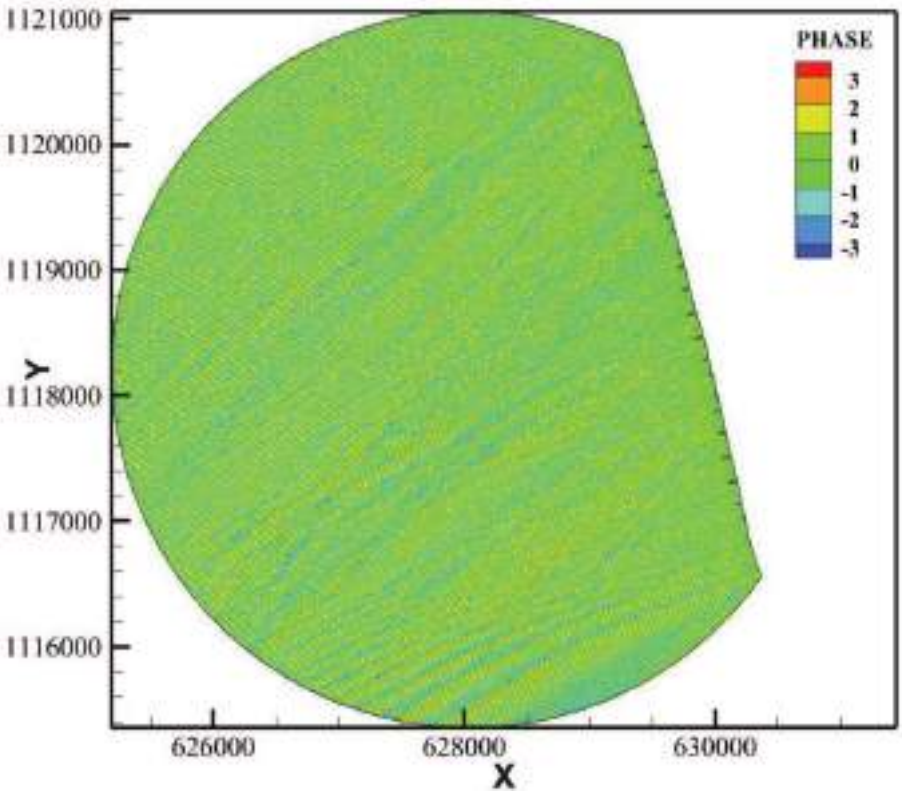


Fig.95b Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 200^0



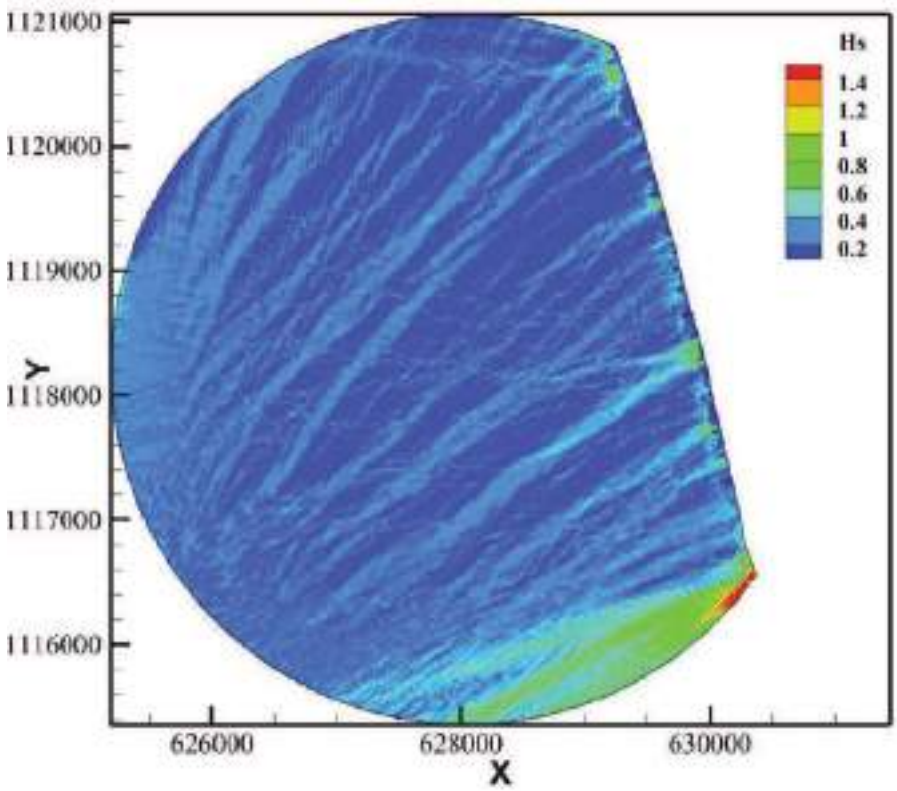
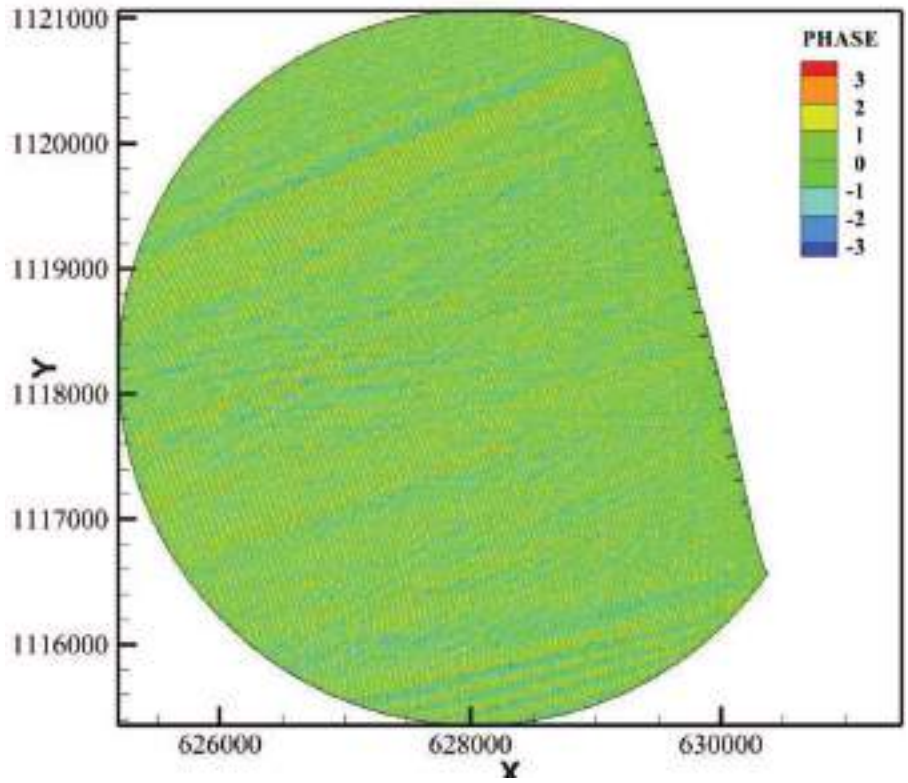


Fig.95c Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 225^0



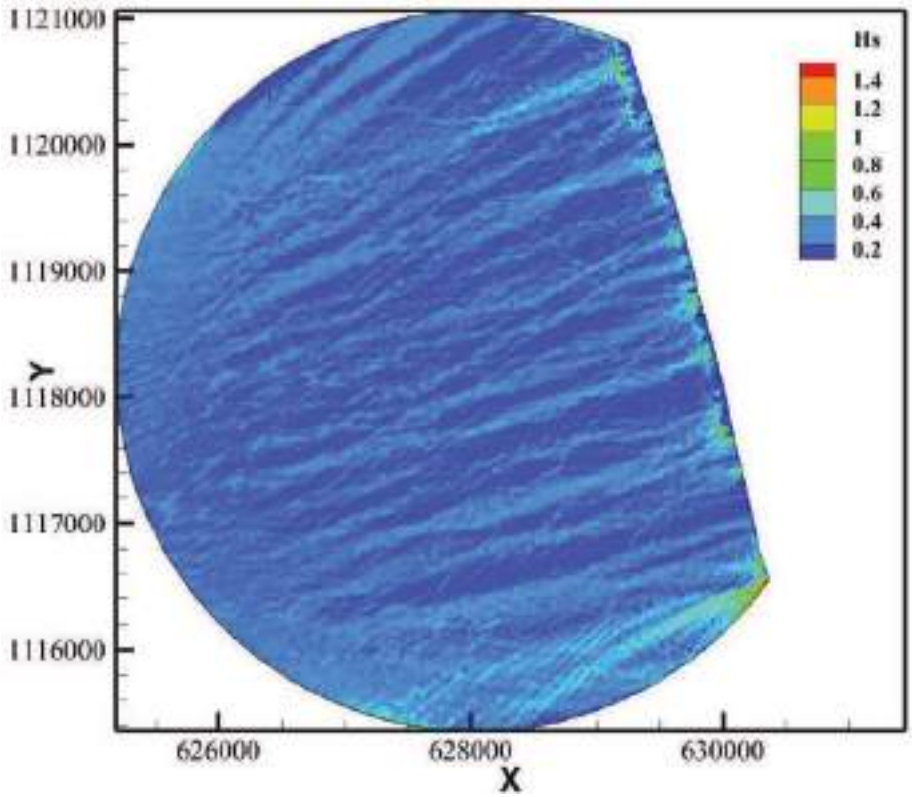
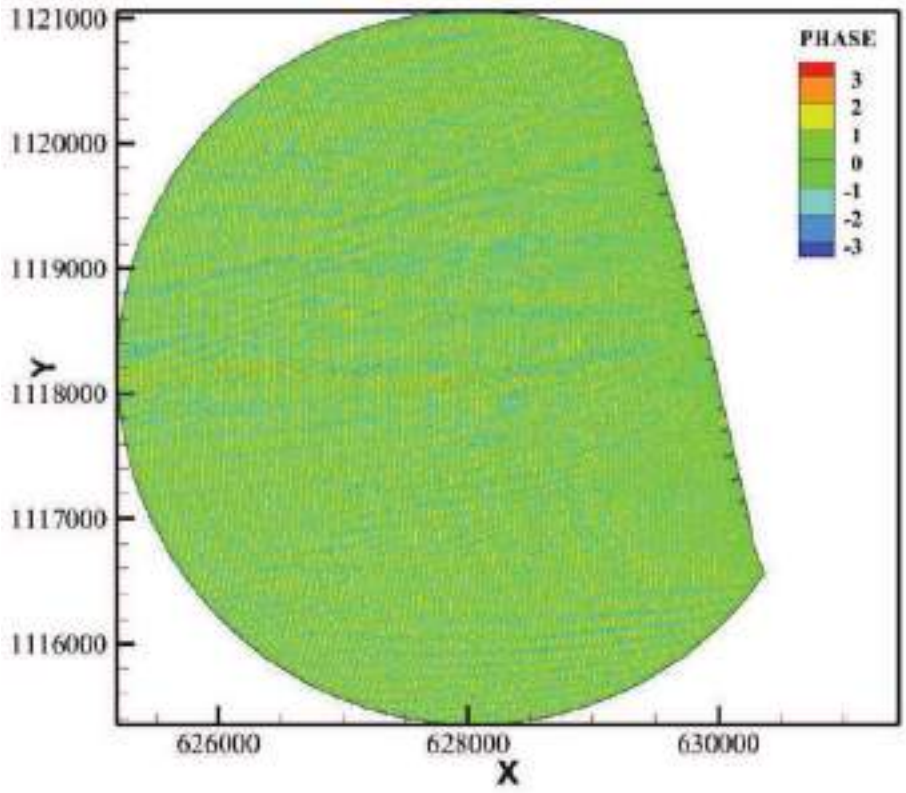


Fig.95d Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 250^0



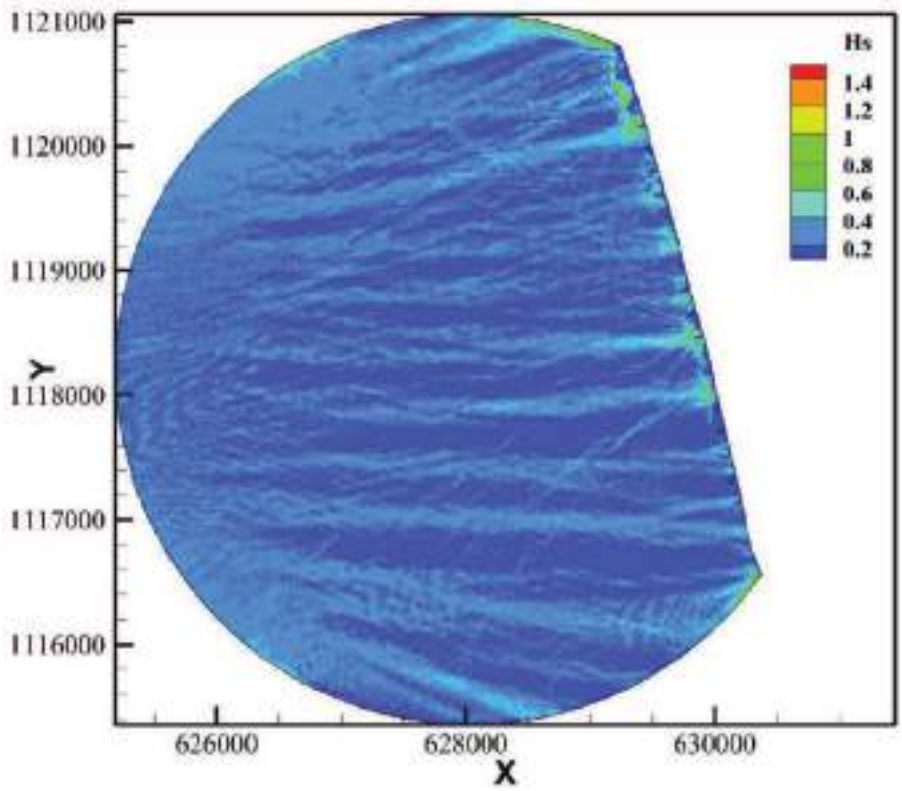
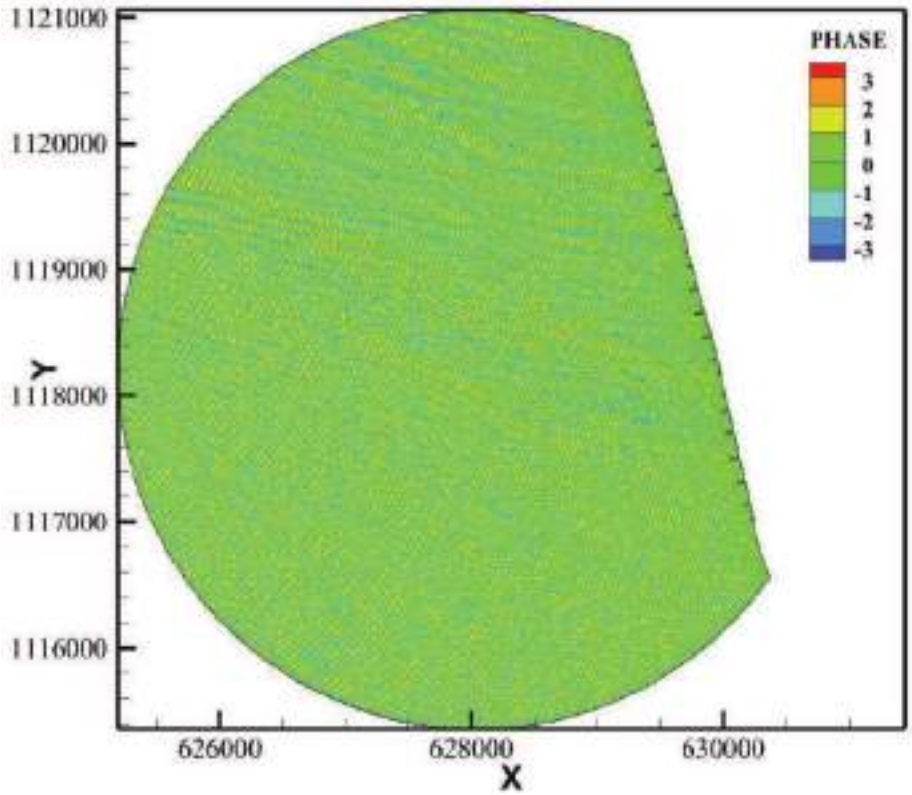


Fig.95e Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 270^0



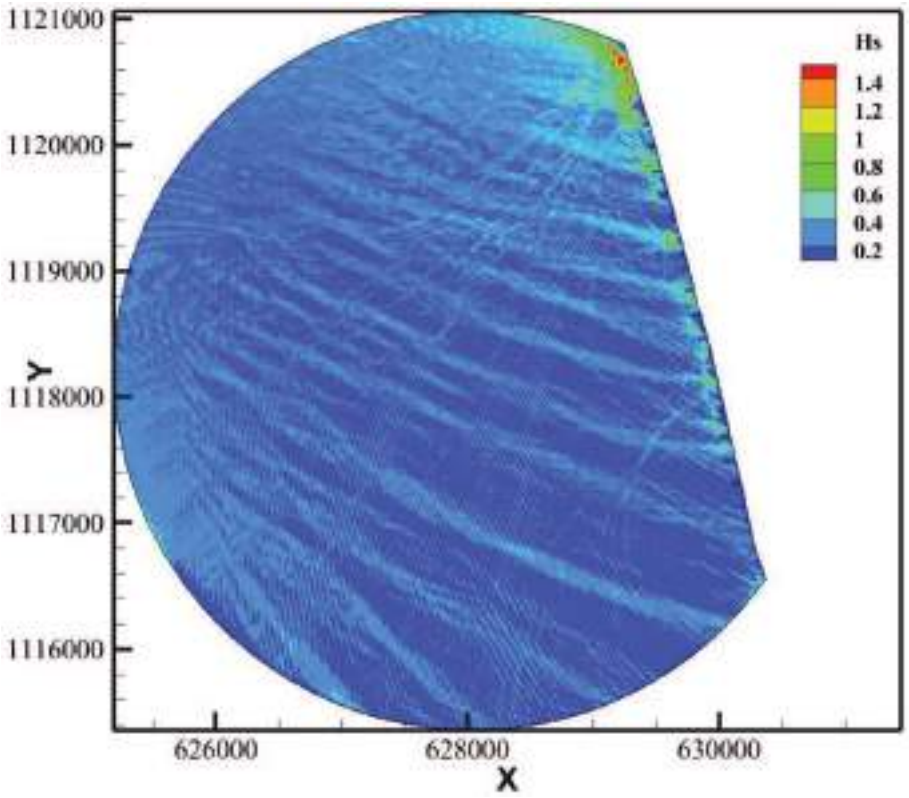


Fig.95f Phase distributions (Meter) and Wave height (Meter) distribution for the wave approach angle from 300^0

13.0 COASTAL PROTECTION STRUCTURES

13.1 Design water level

Following design, data has been adopted for the design of the tetrapod section. The Mean high-water level was +1.05m CD. For the design of the section, MHWL is adopted as the maximum water level.

The design water level for the Groyne can thus be set as the sum of MHWS and the design water depth is,

d = 3.5+1.05+1.2= 5.75m, where, +1.2m surge is considered.

H_{max} = 0.78 x 5.75 = 4.48 m

Significant wave Height = H_{max} /1.6 = 2.80m, considered design wave height is 2.80m.

13.2 Design of Groynes

A typical design of Groyne is detailed below.

Armour Layer

The size of the armour stones for the Groyne section is calculated by using the Hudson formula, which is recommended by CERC (1984). Tetrapods are used as armour stones.

$$W = \frac{W_r H_D^3}{K_D (S_r - 1)^3 \cot\theta} \quad (12)$$

Where, W=Weight of an individual armour unit in the primary cover layer, W_r =Unit weight of Tetrapods, 2.4 T/m^3, H_D =Design wave height at the structure site in meter, S_r =Specific weight of armour unit relating to water at the structure S_r = (W_r / W_w), W_w =Unit weight of seawater = 1025 kg/m^3, θ=Angle of structure slope measured with the horizontal in degree =1:1.5 (Chosen)

K_D =Stability coefficient is 7 for tetrapod and 2 for rough quarry stones in breaking condition for trunk section and Stability coefficient is 5.0 for tetrapod for head section.

From Hudson's formula, the weight of the Stone is worked out to be 4T in two layers to withstand the design wave height of 2.80m at the maximum water depth.

Thickness of armour/under Layer

The thickness of single armour or under layer, t is equal to the mean diameter of stones in that particular layer. However, if there are n numbers of layers, then the thickness is,

$$t = nk_\delta D_{n50} \quad (13)$$

Where, kδ is the layer coefficient in the range of 1.0 to 1.04 for stones rough quarry stones and teratpods respectively.

The thickness of the armour layer is calculated by following,

$$t = nK\delta\left[\frac{w}{w_r}\right]^{\frac{1}{3}} = 2.50$$

2.50m thickness was adopted for armour layer.

Under layer

The size of stone in toe mound is taken as W/10 to W/15 (as per CERC, 1984).

Rough angular quarry stones of weight 500 Kg to 800 Kg are suggested for toe layer for which W_r =2650 kg/m^3 with 1.25m thickness for the trunk and head portion.

Core layer

The size of stone in core layer is 100 kg to 300 kg rough angular quarry stones are suggested for core layer for which W_r =2650 kg/m^3.

Toe Mound

The size of stone in toe mound is taken as W/10 to W/15 (as per CERC, 1984).

Rough angular quarry stones of weight 500 Kg to 800 Kg are suggested for toe layer for which W_r =2650 kg/m^3 with 1.25m thickness for the trunk and head portion.

Crest width

The crest width, r is the maximum of the following: First depends on the minimum number of stones (n) required. SPM (1984) suggests n_{min} = 3. Next, the width depends on the degree of overtopping.

$$r = \max(nk_\delta D_{n50},\ construction/\ functional\ requirement)$$

Crest width, r is arrived from the formula

$$r = nK_\delta \left[\frac{W}{W_r}\right]^{\frac{1}{3}} \qquad (14)$$

Where, n - number of tetrapod's or stones on the crest (n=2), K_δ is layer coefficient, W - mass of armour unit and Wr - Mass density of armour unit kg/m^3

Hence, Crest Width = 4m

Crest elevation

The groyne height or the crest elevation is an important parameter in the groyne design.

Crest elevation above the maximum high-water line = MHWS + Storm surge + R + FB

MHWS – Mean high water spring, R – Wave run-up, FB- Free board, Minimum height of 0.5m shall be adopted.

The wave run-up over the groyne slope is calculated from the design wave height (Hs) and surf similarity parameter (ζ).

$$\zeta = \frac{\tan \propto}{\sqrt{s_{om}}} \qquad (14)$$

Crest elevation = 0.5+Wave run-up + Storm surge + MHWL

= 0.5+2.7+1.2+1.05=5.4m~5.5m

Freeboard may be adopted in calculating the design elevation to give free height for exceptional cases of storms and cyclone waves that hit the toe of the structure to avoid dangers. For Groynes, (+) 5.5m crest elevation is maintained up to +1.05 m (HTL) cross-sections.

Filter layer

The size of stone in the filter layer is taken as 1 kg to 10 kg Rough angular quarry stones are for which W_r =2650 kg/m^3. The thickness of the filter layer is 0.3m.

The detailed cross-sections and head-sections drawings of the proposed conventional groynes at varying water depths are given in **Plates 9** to **14**.

13.3 Design of geo-textile units

13.3.1 General

The wave characteristics adopted for the design of groynes are followed in this section as well. The cross-section of the low crested groynes (see **Plates 15** and **16**) in the coastal stretch between Saidh Mohammed beach and Cherai beach comprises of geo-containers and geo-bags. The cross-section and longitudinal section details corresponding to the option 1 of proposed shore protection works of the stretch from Saidh Mohammed beach to Cherai beach is given in **Plates 17**, **18** and **19**. The cross-sections details arrived for the offshore submerged geo-tubes (see **Plate 20**) is to be adopted for both the tourism destination sites namely Valappu beach Beach and option 2 of the stretch from Saidh Mohammed beach to Cherai beach.

13.3.2 Geo-tubes

Geo-tubes made out of polypropylene are widely used in the construction of nearshore/offshore detached reefs parallel to the coast. These structures have proven to be a better solution for coastal protection and aids in the formation of wide beaches. It can potentially be combined with beach nourishment for rapid beach stabilization. These tubes are often filled hydraulically with a slurry of sand and water, although many other fill materials may also be used. Each fill port may consist of a Geotextile sleeve having a length of at least 1.5 m and a circumference slightly greater than that of the filling pipe. Sometimes a double layer of sheets of woven textiles may also be required in consideration of added UV protection for prolonged life and sufficient abrasion resistance. A single unit of the geo-tube can be 20~25 m in length. The technical design specifications of the geo-tubes are given in the following **Table 27.**

Table 27. Design specifications for geo-tubes

Technical parameter	Test method	Value
Weight per unit volume (GSM)	ASTM D 3776	≥ 330 g/m^2
Tensile strength (Warp/Weft)	IS 1969	≥80/78 KN/m
Wide width tensile strength (MD/CD)	ISO 10319	≥ 200 KN/m
Nominal Tensile elongation (MD/CD)	ISO 10319	≤ 10 %

Elongation at designated peak tensile load (Warp/Weft)	IS 1969	Both ≤ 25%
Trapezoidal tear strength (Warp/Weft)	ASTM D 4533	Both 1600 N
Seam strength (CD)	ISO 10321	≥ 160 KN/m
Abrasion resistance	ASTM D 4886	≥ 80 %
UV resistance at 500 hours	ASTM D 4355	≥ 90 %
CBR Puncture strength	ISO 12236	≥ 22 KN
Puncture strength	ASTM D 4833	≥ 600 N
Water permeability	ASTM D 4491	≥18 l/m^{2}s
Apparent Opening Size (AOS)	ASTM D 4751	≥250 microns
Pore Size O90	ISO 12956	0.35 mm

13.3.3 Geo-textile Mattress

The ***geotextile mattress*** is made of 2 layers (bottom layer and top layer GSM >= 400 g/m^2 and 650 g/m^2 respectively; bottom layer and top layer tensile strength 42 KN/m^2 and 77 KN/m^2 respectively) -a flat bottom layer and top layer consisting of semi-circular pockets (0.5m diameter and 0.3m height). A lap distance of minimum 1m should be provided between the adjacent mattresses with an AOS of 70 microns.

13.3.4 Geotextile containers and bags

Geotextile containers and bags are similar units with an exception that the bags are smaller in size compared to the containers. The containers herein were a used for core of the groynes and the bags constitute the toe layer.

Geosynthetic containers are designed to withstand stresses developed while filling (placing) and under the marine loadings expected on the structure. The aperture opening should be selected such that soil is retained and water is drained out during filling. The geosynthetic containers placed under water are little affected by UV radiations. In the inter-tidal zone, the geosynthetics are covered very soon by algae which provide sufficient UV protection. Geotextile containers are generally manufactured using polypropylene or polyester fabric. Performance of polyethylene for exposure to various environments (Pilarczyk, 2000) is shown in **Table 28**.

Table 28. Performance of High-density polyethylene

Type of exposure	Short term	Long term
Dilute acids	Good resistance	Good resistance
Concentrated acids	Good resistance	Good resistance
Dilute alkali	Good resistance	Good resistance
Concentrated alkali	Good resistance	Good resistance
Salt (prine)	Good resistance	Good resistance
Oil (mineral)	Passable	Moderate
glycol	Good resistance	Good resistance
Micro organisms	Good resistance	Good resistance
UV light	Moderate	Not resistant
UV stabilized	Good resistance	Passable
Heat/dry <100° C	Passable	Moderate
Steam < 110° C	Passable	Moderate
Hydrolysis (moisture absorption)	Good resistance	Good resistance
Detergents	Good resistance	Good resistance
Tendency to creep	Passable	Moderate

The dimension of the designed geotextile container and geotextile bag at 80% volume fill condition is 1.5m x 0.9m x 0.5m and 1.2m x 0.68m x 0.32 m (in length x width x height) respectively. The dry weight of the geotextile container unit should be about 800 kg per container and the submerged weight of the container should be 450-500 kg per container. The dry weight of the geotextile bag unit should be about 330 kg per bag and the submerged weight of the bag should be about 200 kg per bag.

The weight and dimensions of the containers/bags were arrived based on the following formula:

$W \text{ (in kg)} = 0.02323*Ss*V^6/[K*(Ss-1)^3]$

Where, V - velocity in m/sec, Ss - specific gravity of protection material (adopted between 1.5 to 1.8), K – Correction Factor = $[1-\sin^2 0/\sin\Psi]^{1/2}$, 0 – Angle of sloping bank, Ψ – Angle of repose of protection material

These units should remain stable against sliding, overturning, and overburden pressures, it was tested for the same and the cross-sections have been found to satisfy the stability conditions listed below.

Oumeraci et al. (2002a, 2002b, 2003)

$$N_{S,slope} = \frac{H_s}{(\rho_E/\rho_w - 1).D} < \frac{C_w}{\sqrt{\xi_0}} \qquad (15)$$

$$D = l.\sin\alpha$$

$$l_c = \frac{H_s^{3/4}\sqrt{T}}{C_w\left(\frac{2\pi}{g}\right)\left(\frac{\rho_{GSC}}{\rho_w} - 1\right)\sqrt{\frac{\sin(2\alpha)}{2}}}$$

$$N_{S,crest} = \frac{H_s}{(\rho_{GSC}/\rho_w - 1).D} < 0.79 + 0.09\frac{R_C}{H_s}$$

$$l_c = \frac{H_s}{\left(\left(\frac{\rho_{GSC}}{\rho_w} - 1\right)\left(0.79 + 0.09\frac{R_C}{H_s}\right)\sin(\alpha)\right)} \qquad (16)$$

Recio (2007)/ Recio and Oumeraci (2010)

$$l_{c,sliding} \geq u^2 \frac{\left[0.5KS_{CD}C_D + 2.5KS_{CL}C_L\mu\right]}{\left[\mu KS_R\Delta g - KS_{CM}C_M\frac{\partial u}{\partial t}\right]}$$

$$l_{c,overturning} \geq u^2 \frac{\left[0.05KO_{CD}C_D + 12.5KO_{CL}C_L\right]}{\left[0.5\Delta KO_R g - 0.1KO_{CM}C_M\frac{\partial u}{\partial t}\right]} \qquad (17)$$

Where,

C_D,C_L,C_M – drag, lift and inertia coefficients; C_W - empirical parameter derived from N_S; D – thickness of armour layer (m); g – acceleration due to gravity; H_s – incident significant wave height (m); K_D – stability coefficient; KO – coefficient accounting for deformation during overturning; KS – coefficient accounting for deformation during sliding; L_0 – deep water wave length; l_c – length of the container (m); N_s – stability number; R_c – crest freeboard (m); α – slope angle of structured slope (˚); ξ_0 – iribarren number; Δ - (ρs/ρw – 1); ρ_s – density of armour unit (kg/m^3); ρ_w - density of water (kg/m^3); ρ_E - density of GSC (kg/m^3).

Geotextile Containers

For this material, the tensile strength, specific density and GSM are of a minimum value of 450 N/mm^2, 950 kg/m^3 and 800 g/m^2 respectively. The apparent opening size is set at 70 microns and it possesses a puncture resistance of 1000 N. The elongation capacity can be upto 25% and

the strain is at 10%. Each geotextile container and bag is to be filled in-situ with locally available sand slurry or other materials and sealed at the open end.

Geotextile bags

These units are similar to the containers except these bags are smaller in size compared to the containers. The containers herein were a used for core of the groynes and the bags constitute the toe layer. The properties of the non-woven geotextile material used for fabrication of geo-bags are highlighted in **Table 29**.

Table 29. Properties of Geo-textile bags

Properties	**Reference for Test Method**	**Values**
Nominal Mass	ISO 9864	≥ 400 grams/m^2
Tensile Strength	ASTM D4595	≥20 kN/m
Tensile Elongation	ASTM D4595	≥40% & ≤ 90%
Puncture Resistance	ASTM D4833	≥ 0.40 kN
Opening size	ASTM D4751	≥0.07mm &≤0.16mm
UV resistance	ASTM D435	70/50 %

13.3.5 Geotextile filter layer

The function of a geotextile filter is to allow water to enter a drainage media (such as gravel or a geosynthetic) while preventing the exchange/movement of soil particles. The physical, mechanical and hydraulic properties of the filter layer to be employed are given in **Table 30**.

Table 30. Properties of Geotextile filter

Physical Properties	Mechanical Properties	Hydraulic Properties
Mass per unit area (IS 1589 (part 1):2011/ASTM D5261) – 280 gm/sq.m	Tensile strength (Wide Width) (IS15891 (Part 3):2011/ASTM D 4595) – 19kN/m	Permeability (IS 14324:1995/ASTM D 4491)- 0.03mm/sec
Thickness (IS 15891 (part2):2011/ASTM D5199) – 2.5mm	Grab Tensile strength (ASTM D4632)- 1090 kN	Apparent opening Size (IS 14294:1995/ASTM D 4751)- 0.09mm

	Trapezoidal Tear Resistance (IS 14293:1995/ASTM D4533) – 445 N	Permittivity (IS 14324:1995/ASTM D 4491)-0.012/sec

14.0 SEQUENCES OF CROSS SECTION OF GROYNES

Malippuram (from south to north)

1. G1- 50m T-groyne at (-1.5 m) water depth.

-1.5m head section → -1.5m trunk section → -1.0m trunk section → -0. 0m trunk section → 0.0m trunk section → +0.5m trunk section → +1.05m trunk section

2. G2- 60m T-groyne at (-1.8 m) water depth.

-1.8m head section → -1.5m trunk section → -1.0m trunk section → -0. 0m trunk section → 0.0m trunk section → +0.5m trunk section → +1.05m trunk section

3. G3- 120m groyne at (-2.7 m) water depth.

-2.7m head section → -2.5m trunk section → -2.0m trunk section → -1.5m trunk section → -1.0m trunk section → -0. 0m trunk section → 0.0m trunk section → +0.5m trunk section → +1.05m trunk section

4. G4- 120m groyne at (-2.5 m) water depth.

-2.5m head section → -2.5m trunk section → -2.0m trunk section → -1.5m trunk section → -1.0m trunk section → -0. 0m trunk section → 0.0m trunk section → +0.5m trunk section → +1.05m trunk section

5. G- 60m T-groyne at (-1.5 m) water depth.

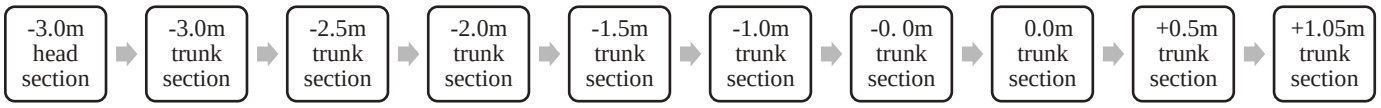
-1.5m head section → -1.5m trunk section → -1.0m trunk section → -0. 0m trunk section → 0.0m trunk section → +0.5m trunk section → +1.05m trunk section

6. G6- 50m T-groyne at (-1.5 m) water depth.

-1.2m head section → -1.0m trunk section → -0. 0m trunk section → 0.0m trunk section → +0.5m trunk section → +1.05m trunk section

Veliyathamparambu

1. Northern Groyne 230m and southern Groyne 170m at (-3.0 m) water depth



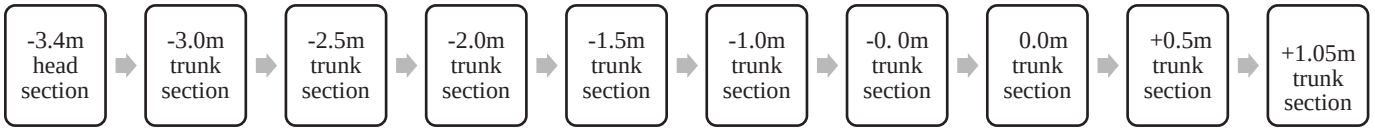
Puthenkadappuram

1. Northern Groyne150m and southern Groyne 130m at (-3.5 m) water depth

Pazhangadu

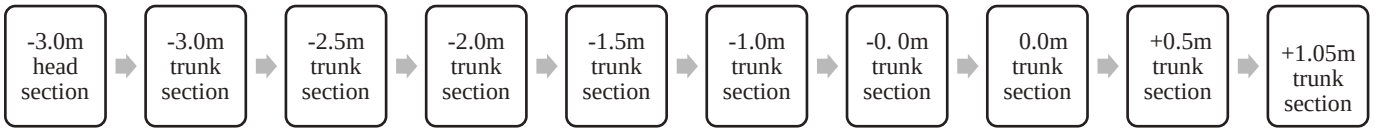
1. Northern Groyne 180m at (-3.5 m) water depth.

2. Southern Groyne 140m at (-3.4 m) water depth.



Saidh Mohammed beach

1. Northern Groyne 160m at (-3.0 m) water depth.



2. Southern Groyne 120m at (-2.5 m) water depth.

Saidh Mohammed beach 2 to Cherai beach (from south to north)

A series of 21 transitional groynes are proposed for this stretch. The details of groyne length and water depth at the head of the structure is given in **Table 31**. The groynes G3, G4, G5,

G10, G11, G12, G17, G18 and G19 are low crested structures with its core composed of geo-containers and the toe section composed of geo-bags.

Table 31. Details of groynes from Saidh Mohammed beach 2 to Cherai beach

Groynes no from south to north	Length of groynes	Water depth
G1	20m	(-) 1.0 M
G2	40m	(-) 1.2 M
G3	**60m**	**(-) 2.0 M**
G4	**70m**	**(-) 3.0 M**
G5	**60m**	**(-) 2.0 M**
G6	40m	(-) 1.5 M
G7	20m	(-) 1.2 M
G8	20m	(-) 1.0 M
G9	40m	(-) 1.5 M
G10	**60m**	**(-) 1.8 M**
G11	**70m**	**(-) 2.0 M**
G12	**60m**	**(-) 2.0 M**
G13	40m	(-) 1.5 M
G14	20m	(-) 1.0 M
G15	20m	(-) 1.0 M
G16	40m	(-) 1.5 M
G17	**60m**	**(-) 2.5 M**
G18	**70m**	**(-) 3.0 M**
G19	**60m**	**(-) 2.5 M**
G20	40m	(-) 1.5 M
G21	20m	(-) 1.2 M

15.0 FINAL RECOMMENDATIONS

The proposed layout and arrived cross-section details are based on the bathymetry data provided to IIT Madras by (KSCADC) & GIDA, KERALA. The layout and the cross-section is expected change if there is significant changes in bathymetry. Hence a detailed bathymetry survey should be extended for all the sites prior to the commencement of construction of the shore protection works. The length of each of the groins within a groin field is a function of depth and has to extend upto the water depth as indicated in this report. A comprehensive bore-hole data study to be executed at all the sites to ensure the geo-technical stability of the proposed gravity structures. A meticulous and continues monitoring of the shoreline changes during the construction phase of the protection is to be carried out and any major deviations from the equilibrium has to be immediately brought to the notice of IIT Madras.

PROF. S. A. SANNASIRAJ **PROF. V. SUNDAR**

REFERENCES

Brocchini, M., Kennedy, A., Soldini, L., and Mancinelli , A. (2004). Topographically controlled, breaking-wave-induced macrovortices. Part 1. Widely separated breakwaters. Journal of Fluid Mechanics. 507. 289 - 307. 10.1017/S002211200400878X.

Calabrese, M., Vicinanza, D. and Buccino, M. (2008). 2D Wave setup behind submerged breakwaters. Ocean Engineering. 35. 1015-1028. 10.1016/j.oceaneng.2008.03.005.

Dolan, R., Fenster, M.S. and Holme, S.J. (1991). Temporal analysis of shoreline recession and accretion. *Journal of coastal research*, pp.723-744.

Mahapatra, M., Ratheesh, R. and Rajawat, A.S. (2014). Shoreline change analysis along the coast of South Gujarat, India, using digital shoreline analysis system. *Journal of the Indian Society of Remote Sensing*, *42*(4), pp.869-876.

Mallik, T.K., Samsuddin, M., Prakash, T.N., Vasudevan, V., and Machado, T. (1987). Beach erosion and accretion—An example from Kerala, Southwest Coast of India. *Environmental Geology and Water Sciences*, *10*(2), pp.105-110.

Kramer, M., Zanuttigh, B., Van der Meer, J. W., Vidal, C., & Gironella, F. X. (2005). Laboratory experiments on low-crested breakwaters. Coastal Engineering, 52(10-11), 867-885.

Oumeraci, H., Bleck, M., Hinz, M., and Kübler, S. (2002a). Großmaßstäbliche Untersuchungenzur hydraulischen Stabilität geotextiler Sand container unter Wellen belastung ("Large-scale investigations into the hydraulic stability of geotextile sand containers under wave loading"). Leichweiss-Institute for Hydraulic Engineering and Water Resources, Report Nr. 878, Braunschweig, Germany (in German).

Oumeraci, H., Bleck, M., Hinz, M., and Möller, J. (2002b). Theoretische Unter suchungenzur Anwendung geotextiler Sand containerim Küstenschutz ("Theoretical studies on the use of geotextile sand containers in coastal protection"). Leichweiss-Institute for Hydraulic Engineering and Water Resources, Report Nr. 866, Braunschweig, Germany, (in German).

Oumeraci, H., Hinz, M., Bleck, M., and Kortenhaus, A. (2003). Sand-filled geotextile containers for shore protection. Proceedings of 6 th conference of Coastal and port Engineering in Developing Countries. COPEDEC VI, Colombo, Sri Lanka. Pp.1-15.

Postacchini, M., Russo, A., Carniel, S., and Brocchini, M. (2016). Assessing the Hydro-Morphodynamic Response of a Beach Protected by Detached, Impermeable, Submerged Breakwaters: A Numerical Approach. Journal of Coastal Research. 32. 10.2112/JCOASTRES-D-15-00057.1.

Recio J (2007). Hydraulic stability of geotextile sand containers for coastal structures- effect of deformations and stability formulae. PhD thesis, Leichweiss-Institute for Hydraulic Engineering Water Resources, Braunschweig, Germany. Pages. 167. doi: 10.24355/dbbs.084-200802050100-0.

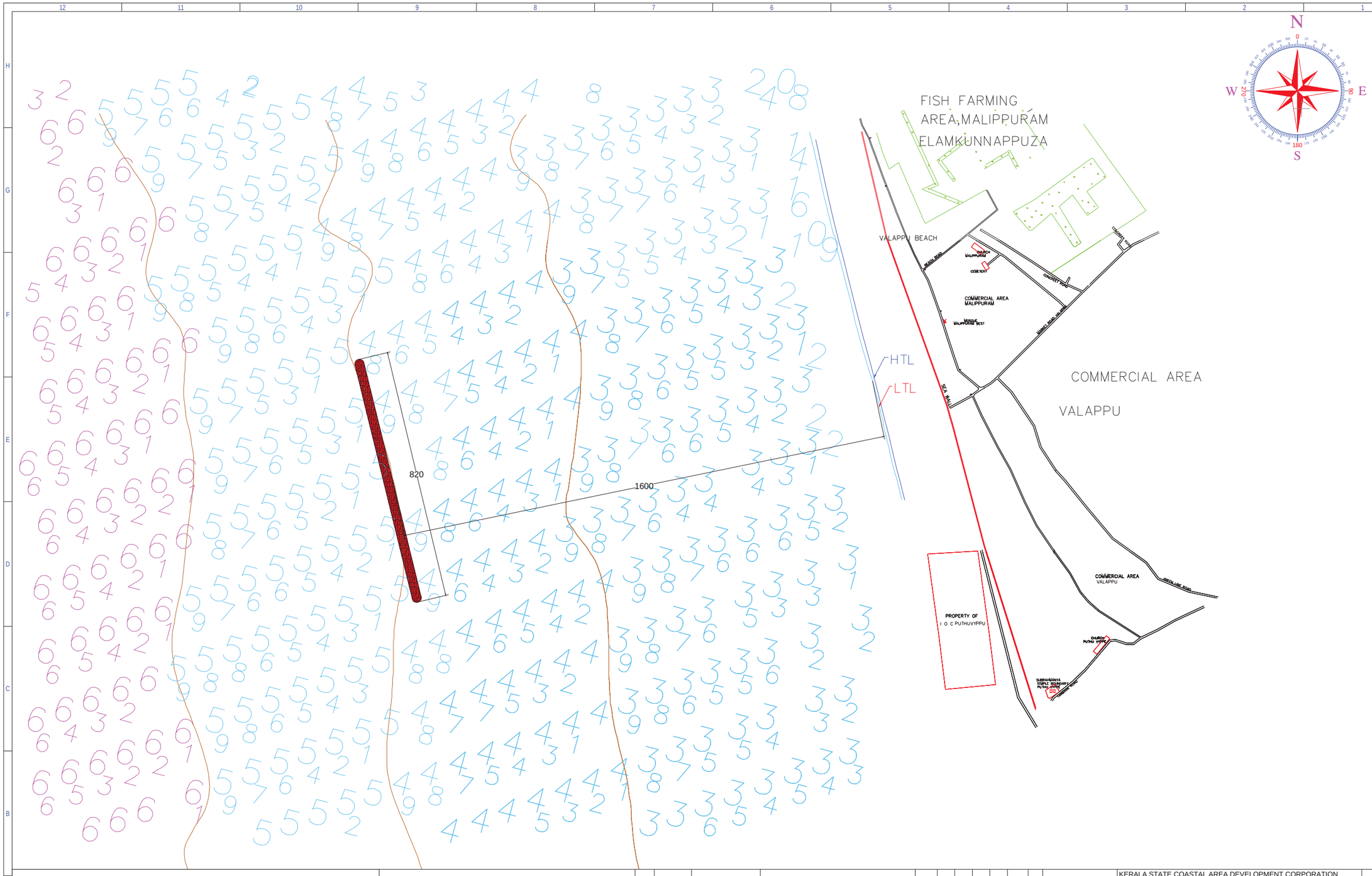
Recio J, Oumeraci H, Mocke G (2010). Stability formula and numerical model for structures made with geotextile sand containers used for coastal stabilization. In 2nd International Conference on Coastal Zone Engineering and Management (Arabian Coast 2010), Muscat, Oman.

Sundar, V., and Murali, K. (2007). “Planning of coastal protection measures along Kerala coast”, *Govt. of Kerala*.

Shahul Hameed, T.S., Kurian, N.P., Thomas, K.V., Rajith, K. and Prakash, T.N., (2007). Wave and current regime off the southwest coast of India. *Journal of Coastal Research*, *23*(5), pp.1167-1174.

Thiruvenkatasamy, K. and Girija, D.B., (2014). Shoreline evolution due to construction of rubble mound jetties at Munambam inlet in Ernakulam–Trichur district of the state of Kerala in the Indian peninsula. *Ocean & coastal management*, *102*, pp.234-247.

Vicinanza, D., Caceres, I., Buccino, M., Gironella, X., and Calabrese, M. (2009). Wave disturbance behind low-crested structures: Diffraction and overtopping effects. Coastal Engineering. 56. 1173-1185. 10.1016/j.coastaleng.2009.08.002.



SUBMERGED GEO TUBES

LEGEND:

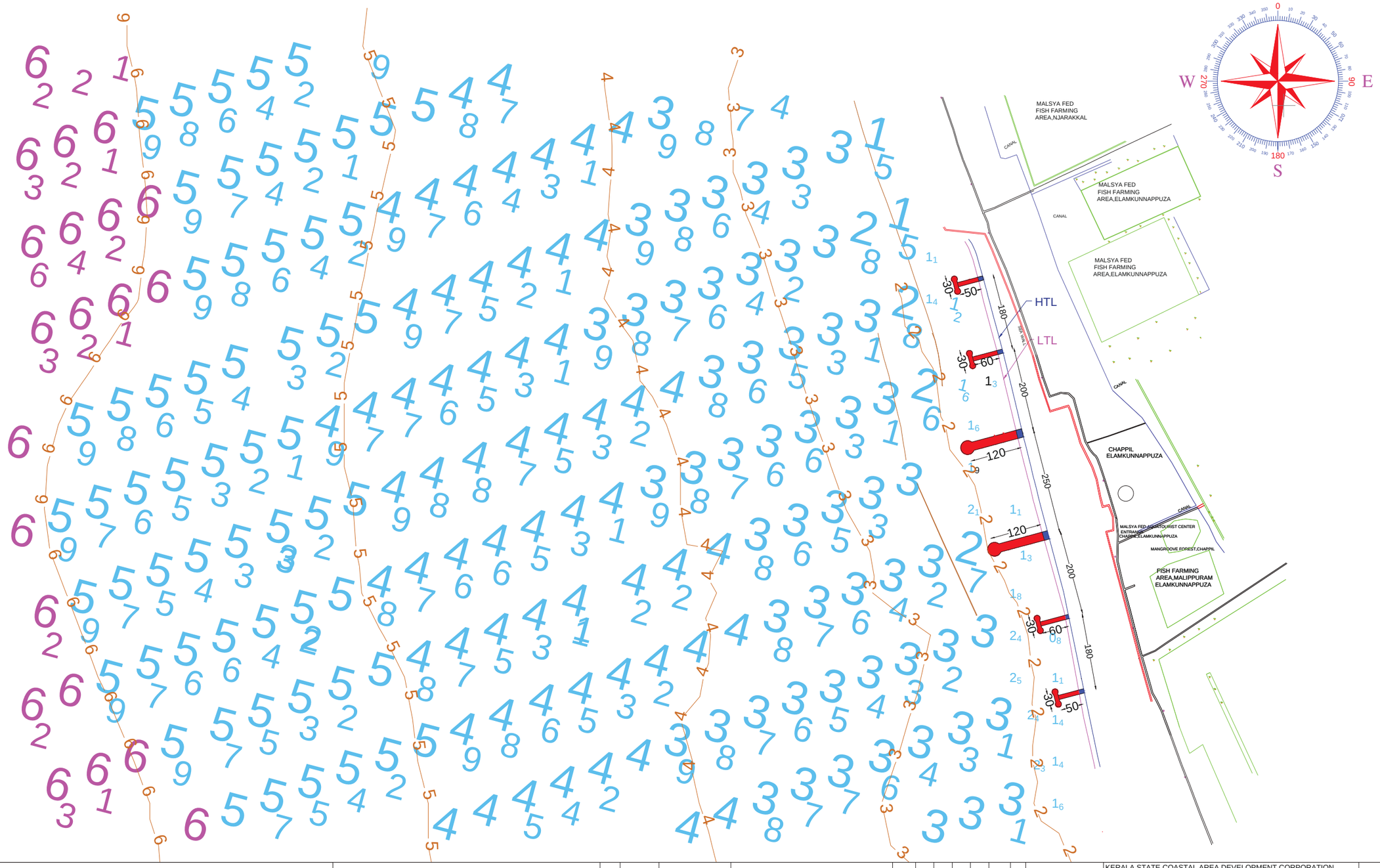
HTL - HIGH WATER LEVEL

LTL - LOW WATER LEVEL

REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

ORIGINAL SIZE:

CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA	DATE 29.04.2022
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT	
DRAWING TITLE:	LAYOUT FOR VALAPPU BEACH (TOURISM DESTINATION)	
DRAWING NO:	1	
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ Prof. V. SUNDAR DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36	



Extended from low tide level to high tide level

Proposed groynes

LEGEND:

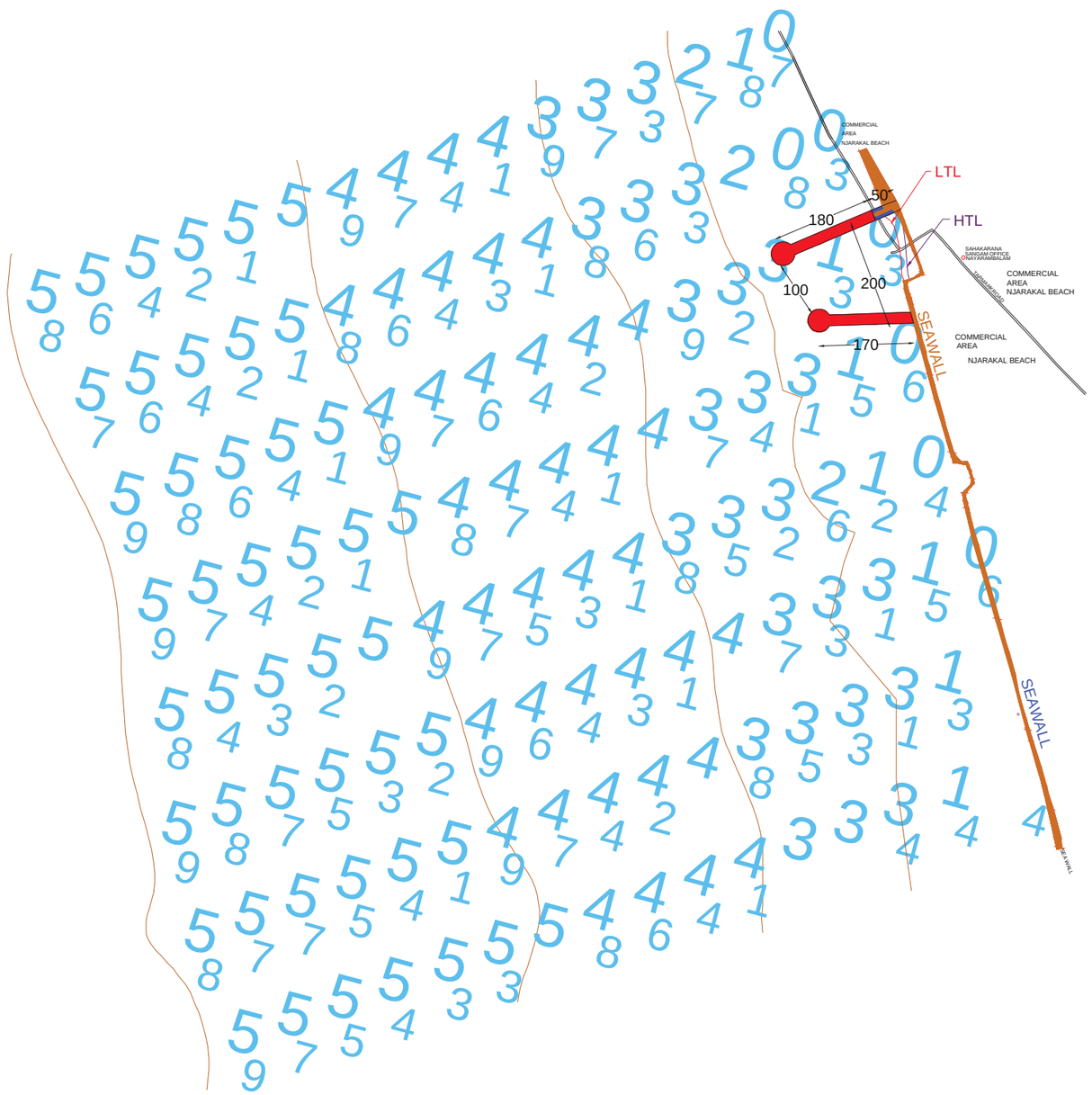
HTL - HIGH WATER LEVEL

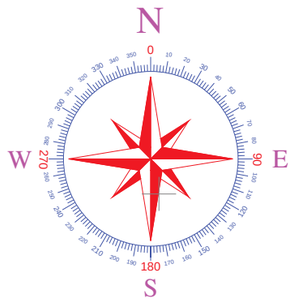
LTL - LOW WATER LEVEL

REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

ORIGINAL SIZE:

CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA	DATE 29.04.2022
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT	
DRAWING TITLE:	LAYOUT FOR MALIPPURAM (FISH LANDING CENTER)	
DRAWING NO:	2	
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ Prof. V. SUNDAR DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36	





Existing groins

Prposed structure

Sea wall

LEGEND:

HTL - HIGH WATER LEVEL

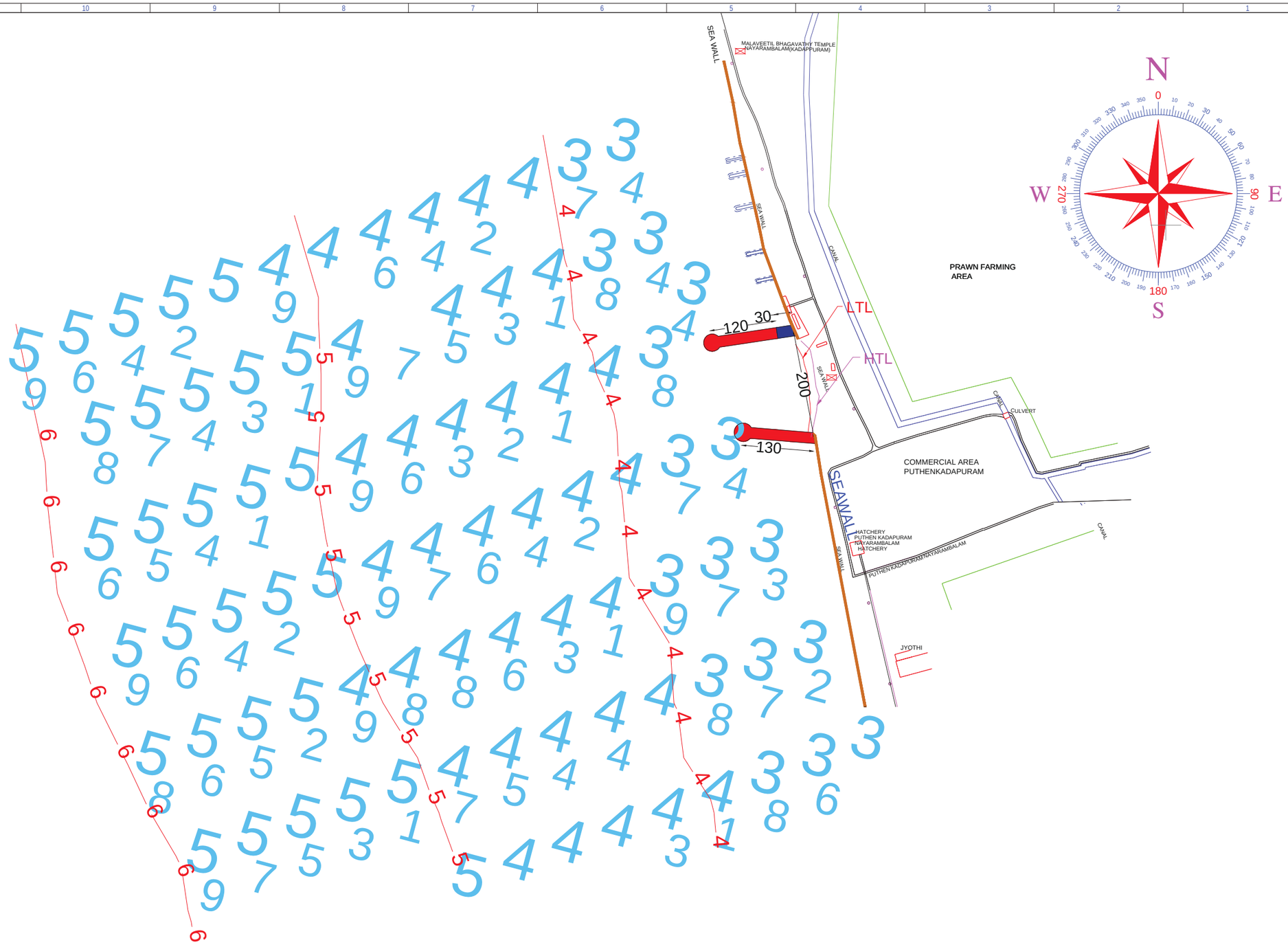
LTL - LOW WATER LEVEL

REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

ORIGINAL SIZE:

CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT
DRAWING TITLE:	LAYOUT FOR VELIYATHAMPARAMBU (FISH LANDING CENTER)
DRAWING NO:	3
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ, Prof. V. SUNDAR DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36

DATE 29.04.2022



Existing groin

Proposed structure

Seawall

LEGEND:

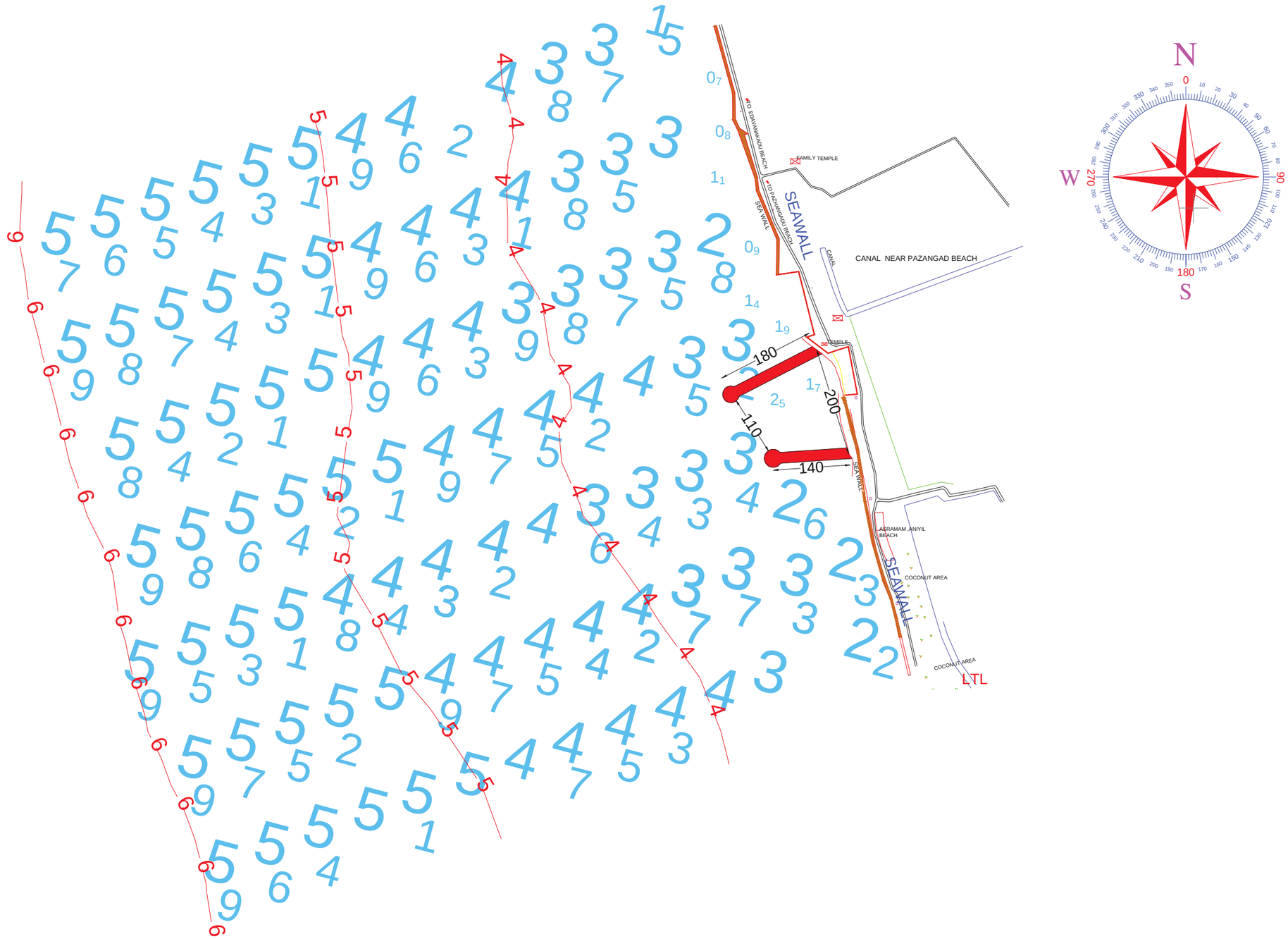
HTL - HIGH WATER LEVEL

LTL - LOW WATER LEVEL

REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

ORIGINAL SIZE:

CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA	DATE 29.04.2022
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT	
DRAWING TITLE:	LAYOUT FOR PUTHENKADAPPURAM (FISH LANDING CENTER),	
DRAWING NO:	4	
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ Prof. V. SUNDAR DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36	



Proposed groins

Seawall

LEGEND:

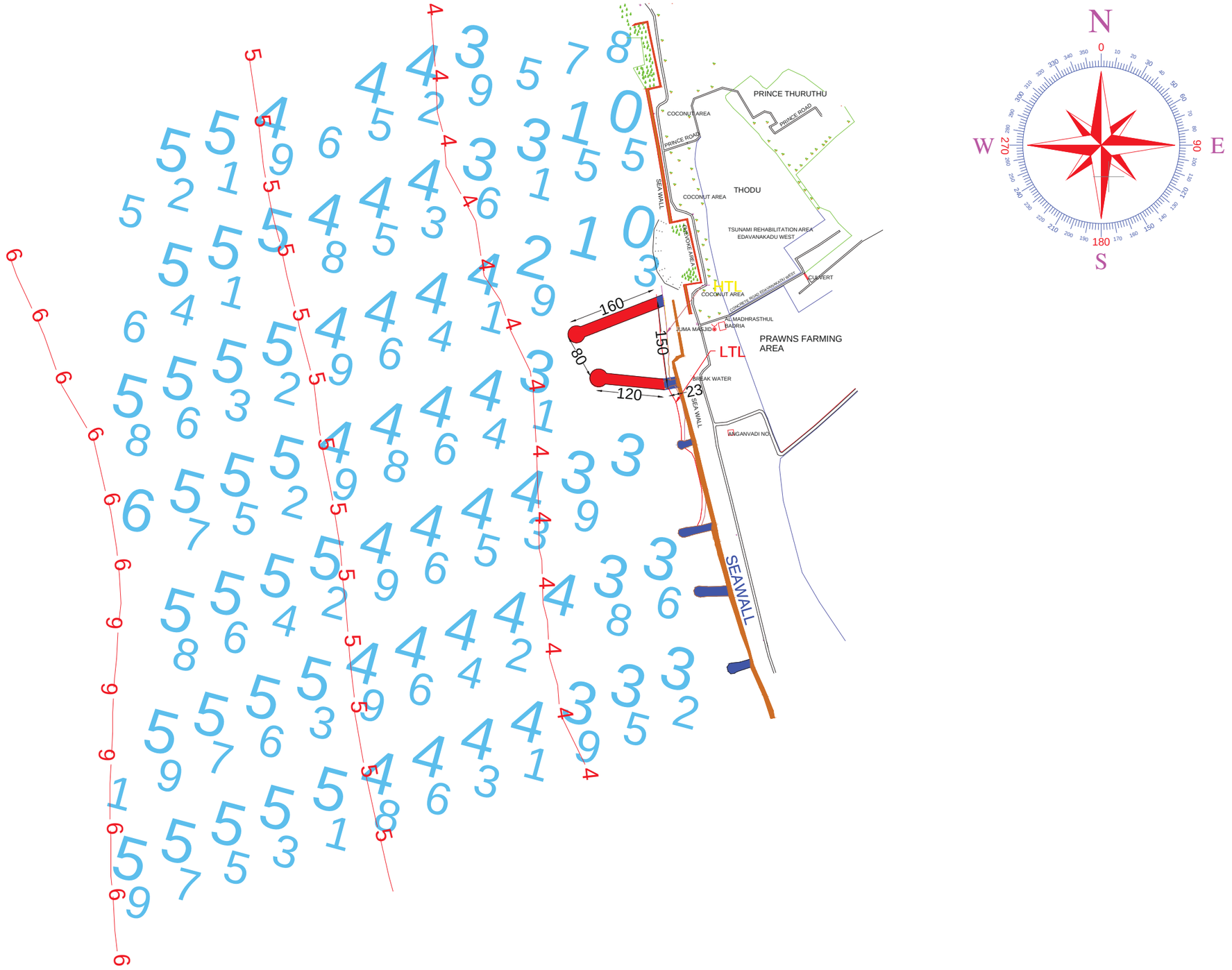
HTL - HIGH WATER LEVEL

LTL - LOW WATER LEVEL

REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

ORIGINAL SIZE:

CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA	DATE 29.04.2022
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT	
DRAWING TITLE:	LAYOUT FOR PAZHANGADU (FISH LANDING CENTER)	
DRAWING NO:	5	
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ Prof. V. SUNDAR DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36	



Existing groin

Proposed structure

Sea wall

LEGEND:

HTL - HIGH WATER LEVEL

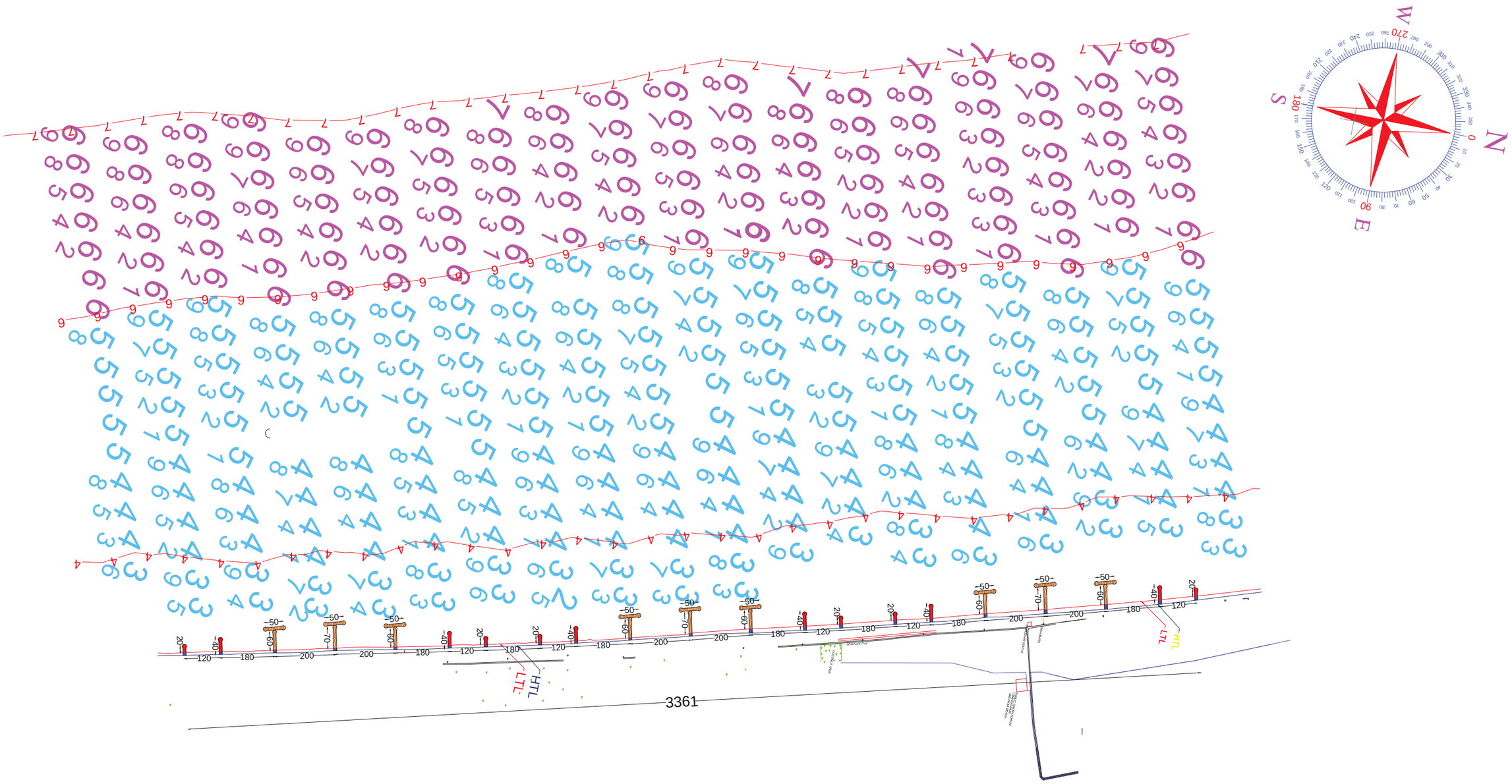
LTL - LOW WATER LEVEL

REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

ORIGINAL SIZE:

CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT
DRAWING TITLE:	LAYOUT FOR SAIDH MOHAMMED BEACH (FISH LANDING CENTER)
DRAWING NO:	6
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ, Prof. V. SUNDAR DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36

DATE 29.04.2022



Proposed Groyne

Groynes exteneding from LTL to HTL

Offshore submerged detached Geo -tubes

Groynes with Geo Containers & Geo bags (short groyne phase 1)

Submerged shore parallel 50m long Geo-tubes/ phase 2

LEGEND:

HTL - HIGH WATER LEVEL

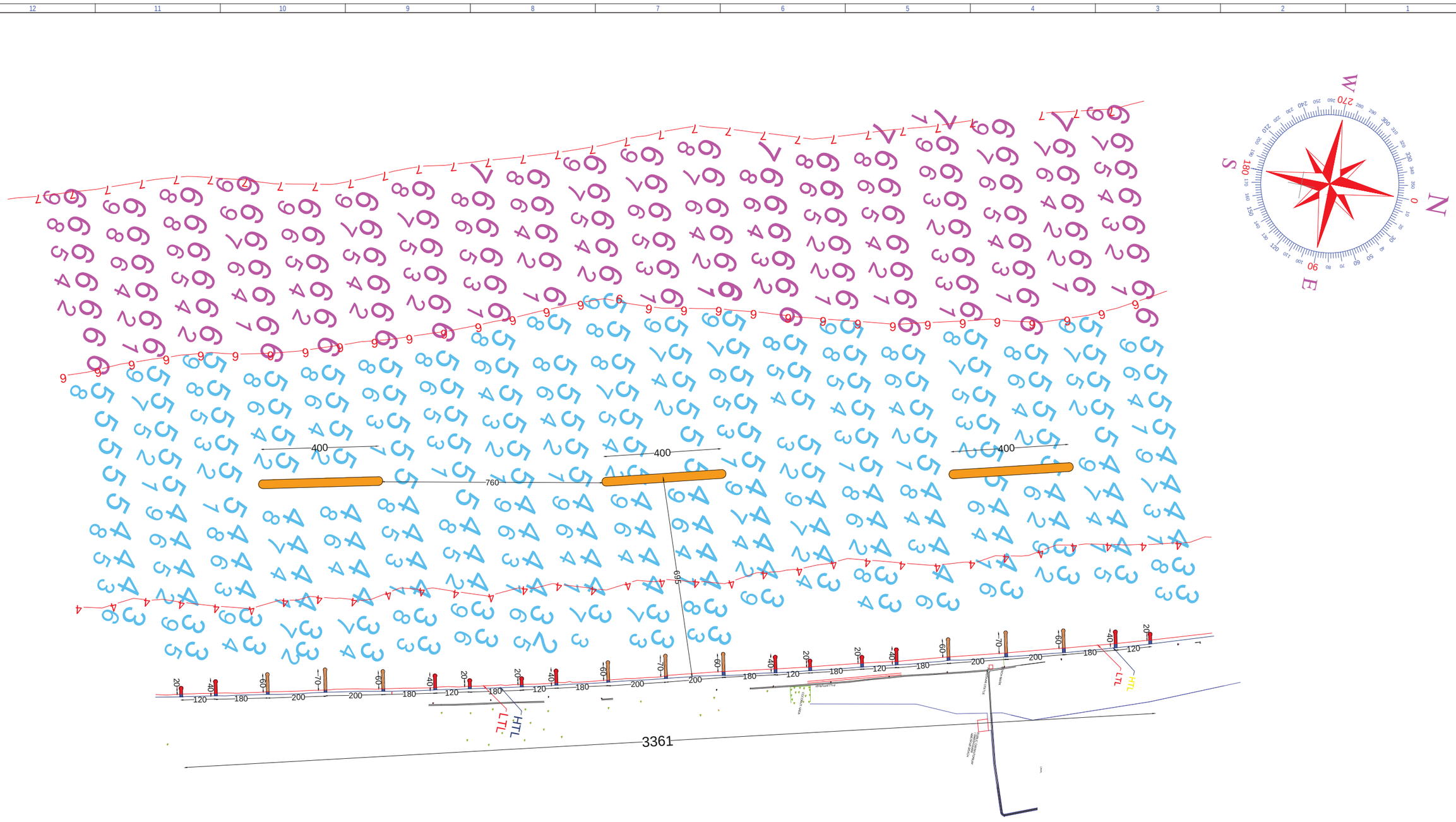
LTL - LOW WATER LEVEL

REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N .	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

ORIGINAL SIZE:

CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT
DRAWING TITLE:	LAYOUT FOR SAIDH MOHAMMED BEACH TO CHERAI BEACH (TOURISM DESTINATION), WITH SERIES OF GROYNES AND SUBMERGED GEO CONTAINERS
DRAWING NO:	7
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ; Prof. V. SUNDAR; DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36

DATE 29.04.2022



Proposed Groyne

Groynes exteneding from LTL to HTL

Groynes with Geo Containers & Geo bags (short groyne phase 1)

Offshore submerged detached Geo- tubes

LEGEND:

HTL - HIGH WATER LEVEL

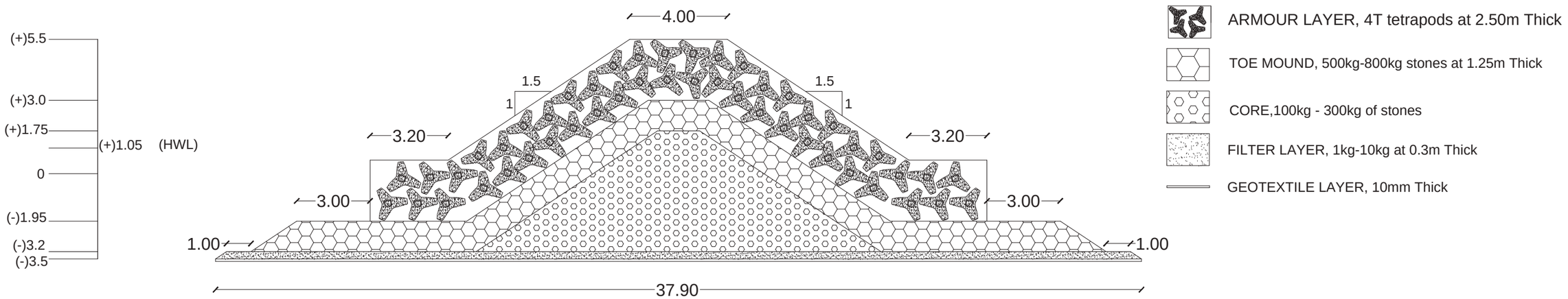
LTL - LOW WATER LEVEL

REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

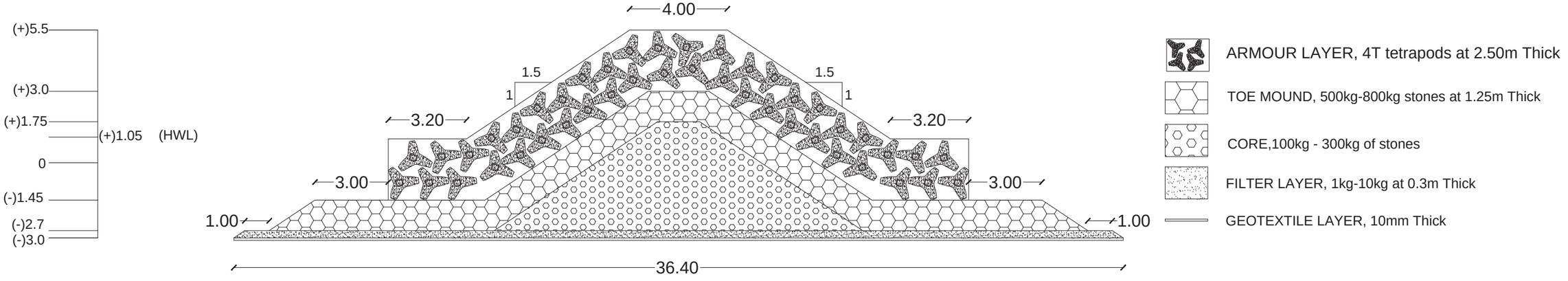
ORIGINAL SIZE:

CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT
DRAWING TITLE:	LAYOUT FOR SAIDH MOHAMMED BEACH TO CHERAI BEACH (TOURISM DESTINATION), WITH SERIES OF GROYNES AND SUBMERGED GEO CONTAINERS
DRAWING NO:	8
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ; Prof. V. SUNDAR; DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36

DATE 29.04.2022



TRUNK SECTION AT (-)3.0m To (-)3.5m WATER DEPTH



TRUNK SECTION AT (-)2.5m To (-)3.0m WATER DEPTH

NOTES :-

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. ALL LEVELS INDICATED ARE IN METERS WITH REFERENCE TO MENTIONED IN BATHYMETRY DATA

LEGEND:

HWL - HIGH WATER LEVEL

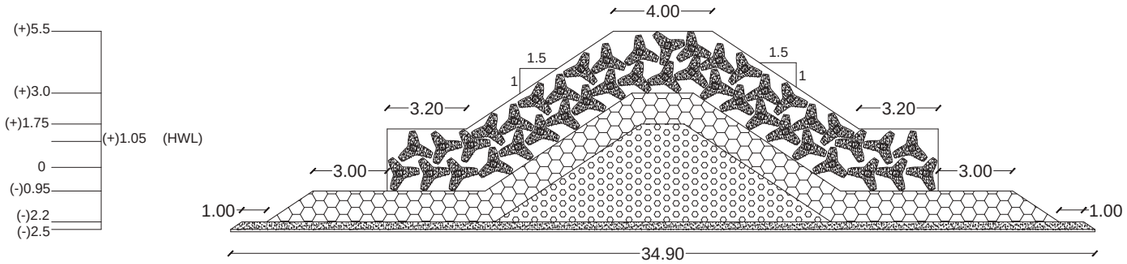
LWL - LOW WATER LEVEL

REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

ORIGINAL SIZE:

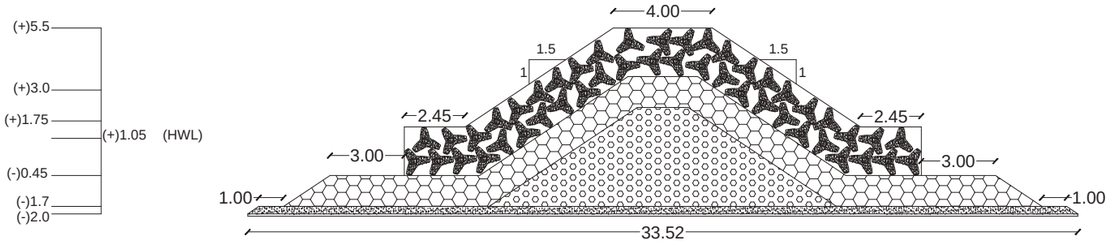
CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT
DRAWING TITLE:	TRUNK SECTION AT (-3.5) AND (-3.0) OF GROYNES
DRAWING NO:	9
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ, Prof. V. SUNDAR DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36

DATE 29.04.2022



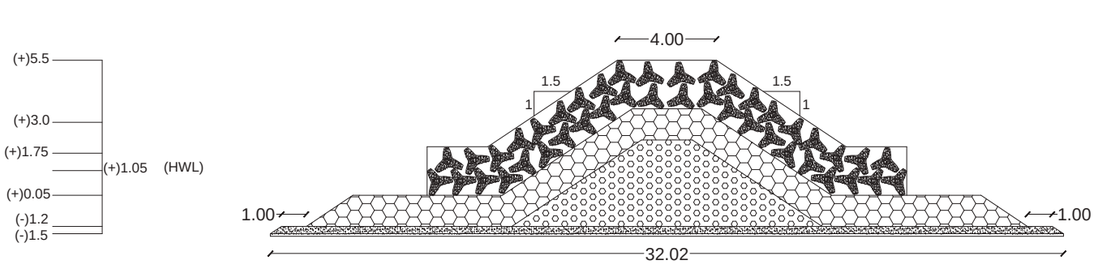
TRUNK SECTION AT (-)2.0m T0 (-)2.5m WATER DEPTH

ARMOUR LAYER, 4T tetrapods at 2.50m Thick
TOE MOUND, 500kg-800kg stones at 1.25m Thick
CORE,100kg - 300kg of stones
FILTER LAYER, 1kg-10kg at 0.3m Thick
GEOTEXTILE LAYER, 10mm Thick



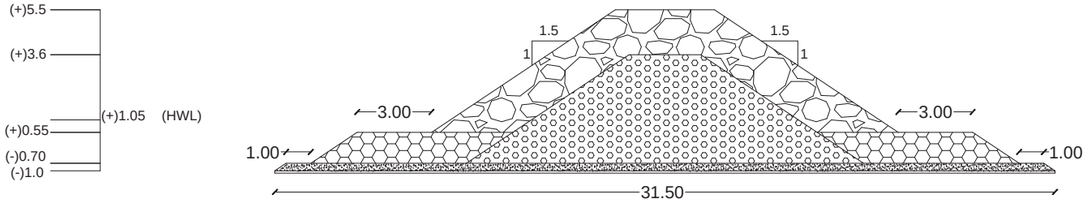
TRUNK SECTION AT (-)1.5m T0 (-)2.0m WATER DEPTH

ARMOUR LAYER, 2T tetrapods at 1.96m Thick
TOE MOUND, 500kg-800kg stones at 1.25m Thick
CORE,100kg - 300kg of stones
FILTER LAYER, 1kg-10kg at 0.3m Thick
GEOTEXTILE LAYER, 10mm Thick



TRUNK SECTION AT (-)1.0m T0 (-)1.5m WATER DEPTH

ARMOUR LAYER, 2T tetrapods at 1.96m Thick
TOE MOUND, 500kg-800kg stones at 1.25m Thick
CORE,100kg - 300kg of stones
FILTER LAYER, 1kg-10kg at 0.3m Thick
GEOTEXTILE LAYER, 10mm Thick



TRUNK SECTION AT (-)0.5m T0 (-)1.0m WATER DEPTH

ARMOUR LAYER, 1.5T to 2.5T of Stones at 2.0m Thick (70% of stones >2.0T)
TOE MOUND, 500kg-800kg stones at 1.25m Thick
CORE,100kg - 300kg of stones
FILTER LAYER, 1kg-10kg at 0.3m Thick
GEOTEXTILE LAYER, 10mm Thick

NOTES :-

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. ALL LEVELS INDICATED ARE IN METERS WITH REFERENCE TO MENTIONED IN BATHYMETRY DATA

LEGEND:

HWL - HIGH WATER LEVEL

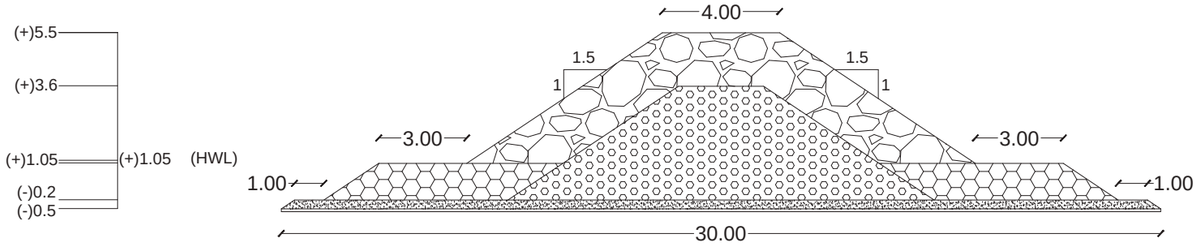
LWL - LOW WATER LEVEL

REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

ORIGINAL SIZE:

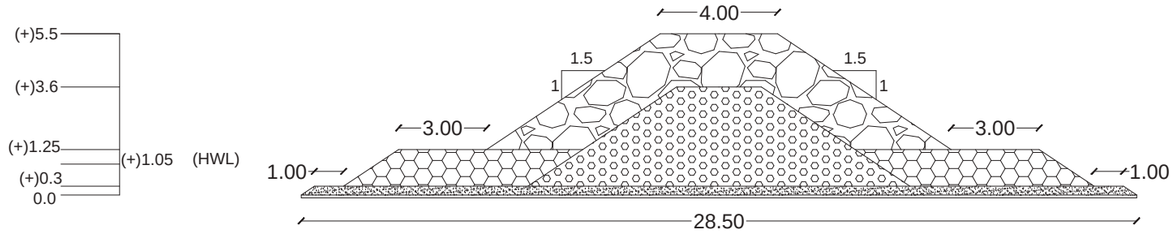
CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT
DRAWING TITLE:	TRUNK SECTION AT (-2.5), (-2.0) ,(-1.5) AND (-1.0) OF GROYNES
DRAWING NO:	10
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ, Prof. V. SUNDAR DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36

DATE 29.04.2022



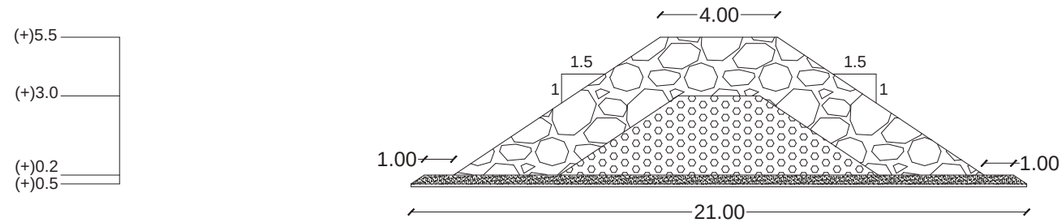
TRUNK SECTION AT (-)0.0m T0 (-)0.5m WATER DEPTH

ARMOUR LAYER, 1.5T to 2.5T of Stones at 2.0m Thick (70% of stones >2.0T)
TOE MOUND, 500kg-800kg stones at 1.25m Thick
CORE,100kg - 300kg of stones
FILTER LAYER, 1kg-10kg at 0.3m Thick
GEOTEXTILE LAYER, 10mm Thick



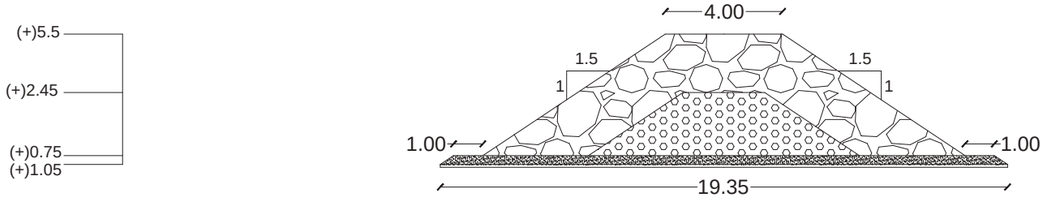
TRUNK SECTION AT 0.0m WATER DEPTH

ARMOUR LAYER, 1.5T to 2.5T of Stones at 2.0m Thick (70% of stones >2.0T)
TOE MOUND, 500kg-800kg stones at 1.25m Thick
CORE,100kg - 300kg of stones
FILTER LAYER, 1kg-10kg at 0.3m Thick
GEOTEXTILE LAYER, 10mm Thick



TRUNK SECTION AT (+0.5)m WATER DEPTH
(from LTL to HTL)

ARMOUR LAYER, 1.5T to 2.5T of Stones at 2.0m Thick (70% of stones >2.0T)
CORE,100kg - 300kg of stones
FILTER LAYER, 1kg-10kg at 0.3m Thick
GEOTEXTILE LAYER, 10mm Thick



TRUNK SECTION AT (+1.05)m WATER DEPTH
(from LTL to HTL)

ARMOUR LAYER, 1.5T to 2.5T of Stones at 2.0m Thick (70% of stones >2.0T)
CORE,100kg - 300kg of stones
FILTER LAYER, 1kg-10kg at 0.3m Thick
GEOTEXTILE LAYER, 10mm Thick

NOTES :-

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. ALL LEVELS INDICATED ARE IN METERS WITH REFERENCE TO MENTIONED IN BATHYMETRY DATA

LEGEND:

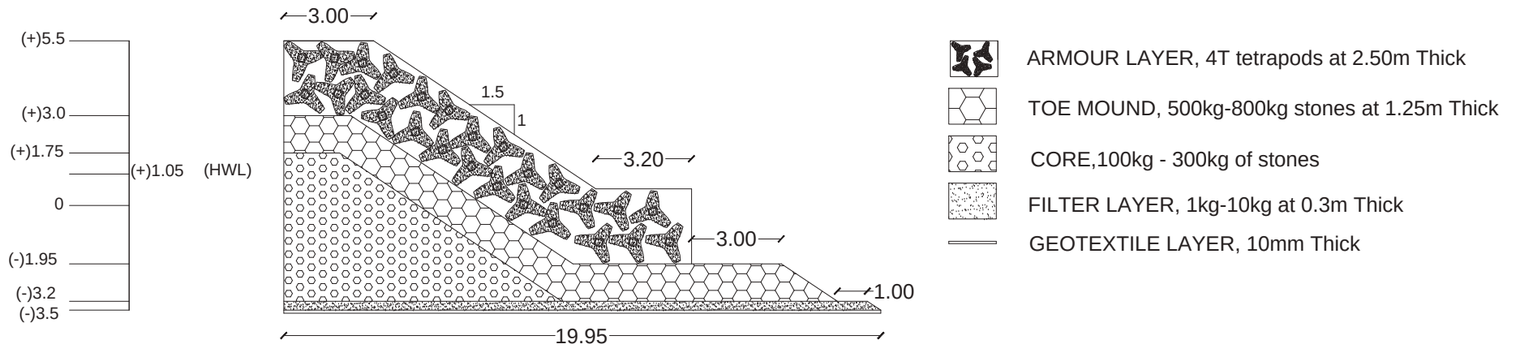
HWL - HIGH WATER LEVEL

LWL - LOW WATER LEVEL

REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

ORIGINAL SIZE:

CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA	DATE 29.04.2022
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT	
DRAWING TITLE:	TRUNK SECTION AT (-0.5), (0.0) ,(+0.5) AND (+1.05) OF GROYNES	
DRAWING NO:	11	
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ; Prof. V. SUNDAR; DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36	



HEAD SECTION AT (-)3.5m WATER DEPTH

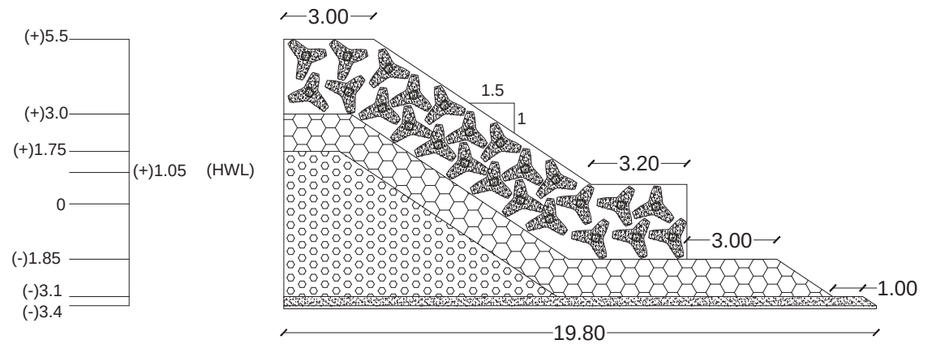
ARMOUR LAYER, 4T tetrapods at 2.50m Thick

TOE MOUND, 500kg-800kg stones at 1.25m Thick

CORE,100kg - 300kg of stones

FILTER LAYER, 1kg-10kg at 0.3m Thick

GEOTEXTILE LAYER, 10mm Thick



HEAD SECTION AT (-)3.4m WATER DEPTH

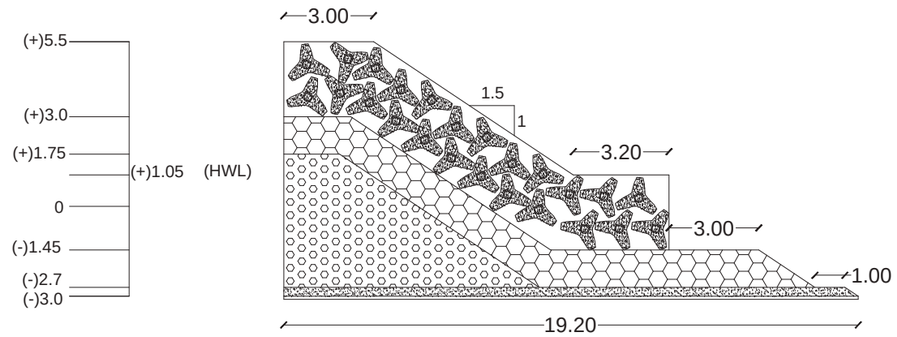
ARMOUR LAYER, 4T tetrapods at 2.50m Thick

TOE MOUND, 500kg-800kg stones at 1.25m Thick

CORE,100kg - 300kg of stones

FILTER LAYER, 1kg-10kg at 0.3m Thick

GEOTEXTILE LAYER, 10mm Thick



HEAD SECTION AT (-)3.0m WATER DEPTH

ARMOUR LAYER, 4T tetrapods at 2.50m Thick

TOE MOUND, 500kg-800kg stones at 1.25m Thick

CORE,100kg - 300kg of stones

FILTER LAYER, 1kg-10kg at 0.3m Thick

GEOTEXTILE LAYER, 10mm Thick

NOTES :-

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. ALL LEVELS INDICATED ARE IN METERS WITH REFERENCE TO MENTIONED IN BATHYMETRY DATA

LEGEND:

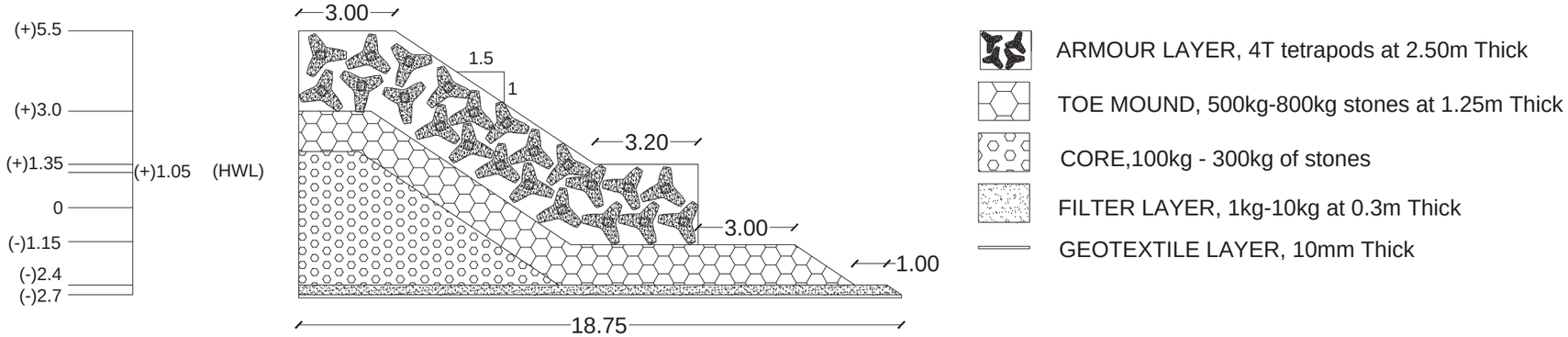
HWL - HIGH WATER LEVEL

LWL - LOW WATER LEVEL

REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

ORIGINAL SIZE:

CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA	DATE 29.04.2022
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT	
DRAWING TITLE:	HEAD SECTION AT (-3.5), (-3.4) AND (-3.0) OF GROYNES	
DRAWING NO:	12	
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ; Prof. V. SUNDAR DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36	



HEAD SECTION AT (-)2.7m WATER DEPTH

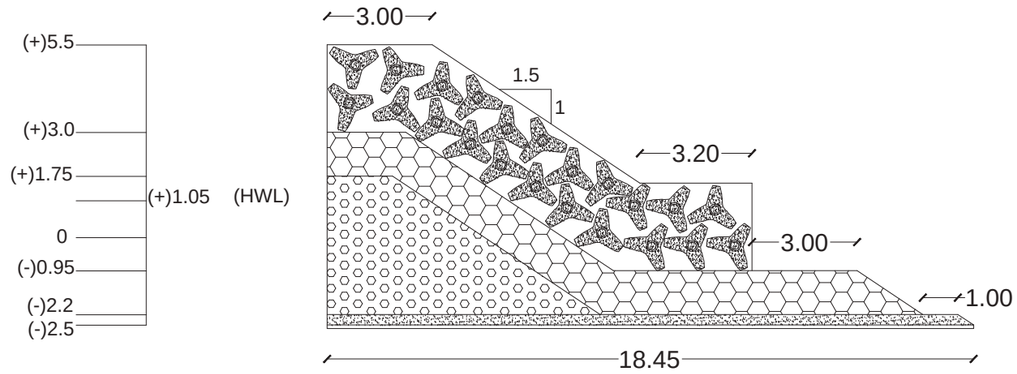
ARMOUR LAYER, 4T tetrapods at 2.50m Thick

TOE MOUND, 500kg-800kg stones at 1.25m Thick

CORE,100kg - 300kg of stones

FILTER LAYER, 1kg-10kg at 0.3m Thick

GEOTEXTILE LAYER, 10mm Thick



HEAD SECTION AT (-)2.5m WATER DEPTH

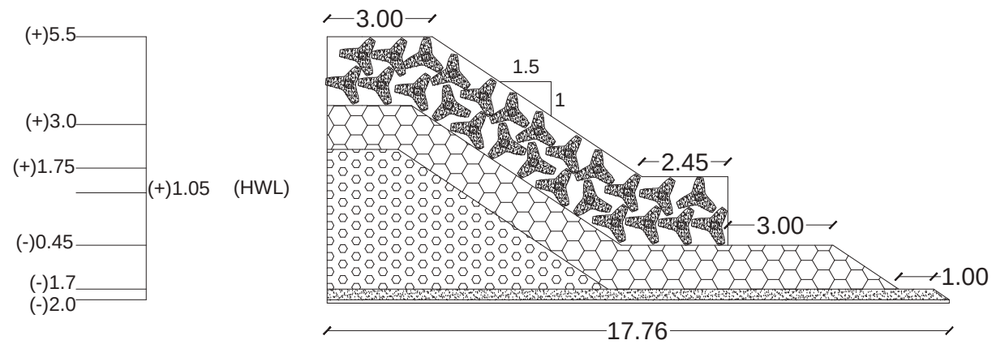
ARMOUR LAYER, 4T tetrapods at 2.50m Thick

TOE MOUND, 500kg-800kg stones at 1.25m Thick

CORE,100kg - 300kg of stones

FILTER LAYER, 1kg-10kg at 0.3m Thick

GEOTEXTILE LAYER, 10mm Thick



HEAD SECTION AT (-)2.0m WATER DEPTH

ARMOUR LAYER, 2T tetrapods at 1.96m Thick

TOE MOUND, 500kg-800kg stones at 1.25m Thick

CORE,100kg - 300kg of stones

FILTER LAYER, 1kg-10kg at 0.3m Thick

GEOTEXTILE LAYER, 10mm Thick

NOTES :-

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. ALL LEVELS INDICATED ARE IN METERS WITH REFERENCE TO MENTIONED IN BATHYMETRY DATA

LEGEND:

HWL - HIGH WATER LEVEL

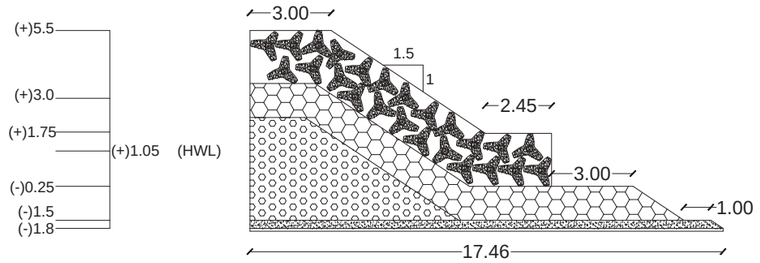
LWL - LOW WATER LEVEL

REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

ORIGINAL SIZE:

CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT
DRAWING TITLE:	HEAD SECTION AT (-2.7), (-2.5) AND (-2.0) OF GROYNES
DRAWING NO:	13
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ, Prof. V. SUNDAR DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36

DATE 29.04.2022



HEAD SECTION AT (-)1.8m WATER DEPTH

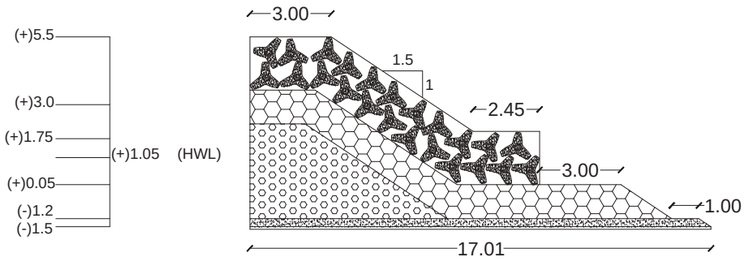
ARMOUR LAYER, 2T tetrapods at 1.96m Thick

TOE MOUND, 500kg-800kg stones at 1.25m Thick

CORE,100kg - 300kg of stones

FILTER LAYER, 1kg-10kg at 0.3m Thick

GEOTEXTILE LAYER, 10mm Thick



HEAD SECTION AT (-)1.5m WATER DEPTH

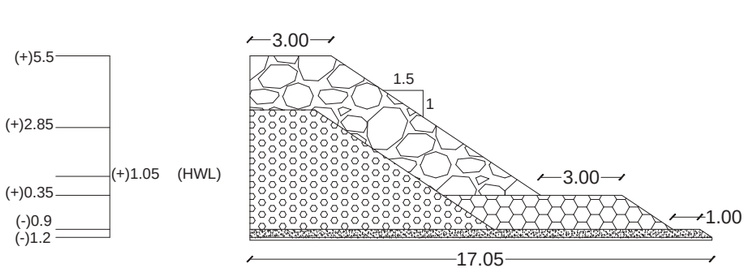
ARMOUR LAYER, 2T tetrapods at 1.96m Thick

TOE MOUND, 500kg-800kg stones at 1.25m Thick

CORE,100kg - 300kg of stones

FILTER LAYER, 1kg-10kg at 0.3m Thick

GEOTEXTILE LAYER, 10mm Thick



HEAD SECTION AT (-)1.2m WATER DEPTH

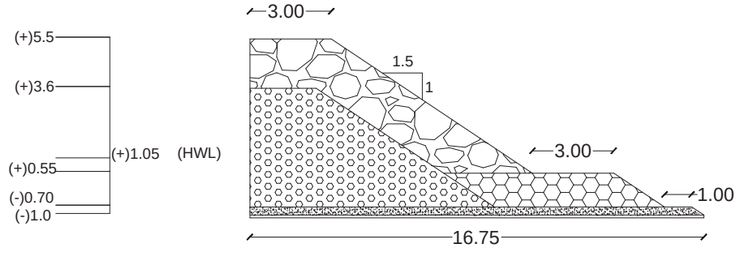
ARMOUR LAYER, 1.5T to 2.5T of Stones at 2.0m Thick (70% of stones >2.0T)

TOE MOUND, 500kg-800kg stones at 1.25m Thick

CORE,100kg - 300kg of stones

FILTER LAYER, 1kg-10kg at 0.3m Thick

GEOTEXTILE LAYER, 10mm Thick



HEAD SECTION AT (-)1.0m WATER DEPTH

ARMOUR LAYER, 1.5T to 2.5T of Stones at 2.0m Thick (70% of stones >2.0T)

TOE MOUND, 500kg-800kg stones at 1.25m Thick

CORE,100kg - 300kg of stones

FILTER LAYER, 1kg-10kg at 0.3m Thick

GEOTEXTILE LAYER, 10mm Thick

NOTES :-

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. ALL LEVELS INDICATED ARE IN METERS WITH REFERENCE TO MENTIONED IN BATHYMETRY DATA

LEGEND:

HWL - HIGH WATER LEVEL

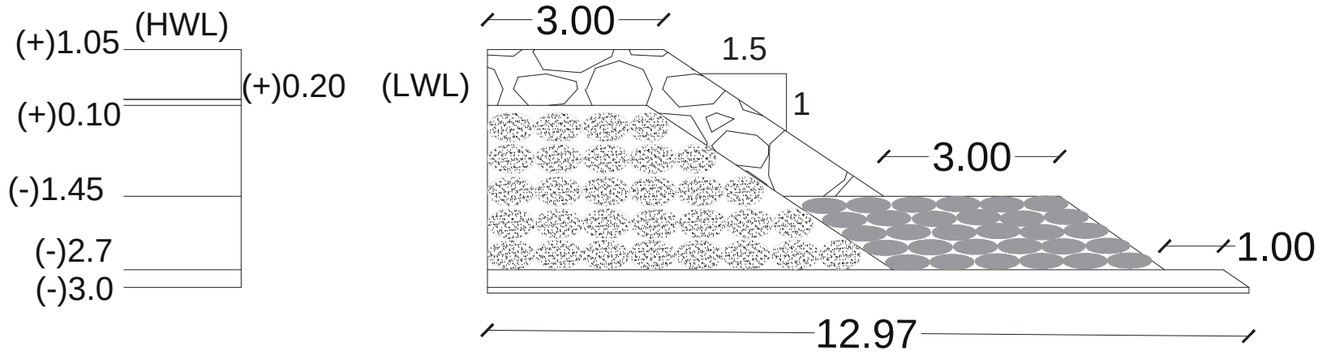
LWL - LOW WATER LEVEL

REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

ORIGINAL SIZE:

CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT
DRAWING TITLE:	HEAD SECTION AT (-1.8), (-1.5),(1.2) AND (-1.0) OF GROYNES
DRAWING NO:	14
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ, Prof. V. SUNDAR DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36

DATE 29.04.2022



HEAD SECTION AT (-)3.0m WATER DEPTH

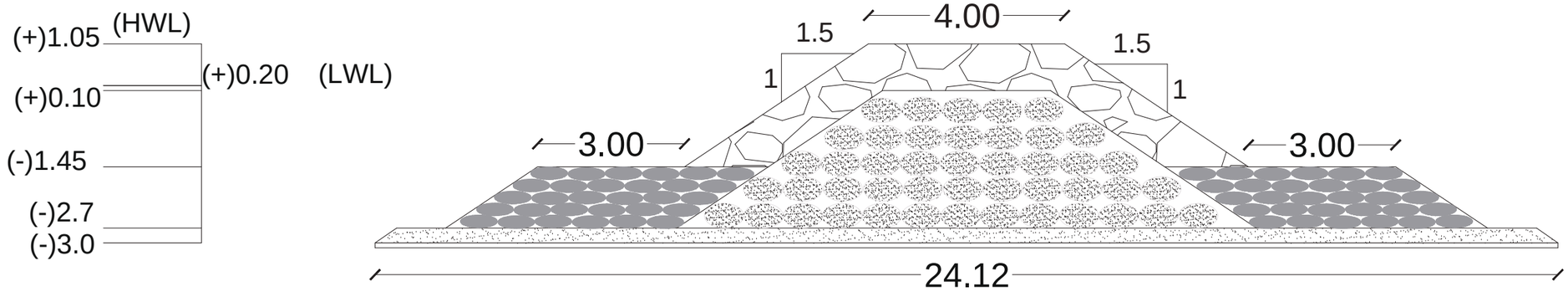
ARMOUR LAYER, 1.5T to 2.5T of Stones at 0.95m Thick (70% of stones >2.0T)

TOE MOUND, Geo-bags at width 0.64m, height 0.25m, length 1m

Core layer, Geo-containers at width 0.8m, height 0.5m, length 1m (450-500kg of sand)

FILTER LAYER, 1kg-10kg at 0.3m Thick

GEOTEXTILE LAYER, 10mm Thick



TRUNK SECTION AT (-)2.5m To (-)3.0m WATER DEPTH

NOTES :-

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. ALL LEVELS INDICATED ARE IN METERS WITH REFERENCE TO MENTIONED IN BATHYMETRY DATA

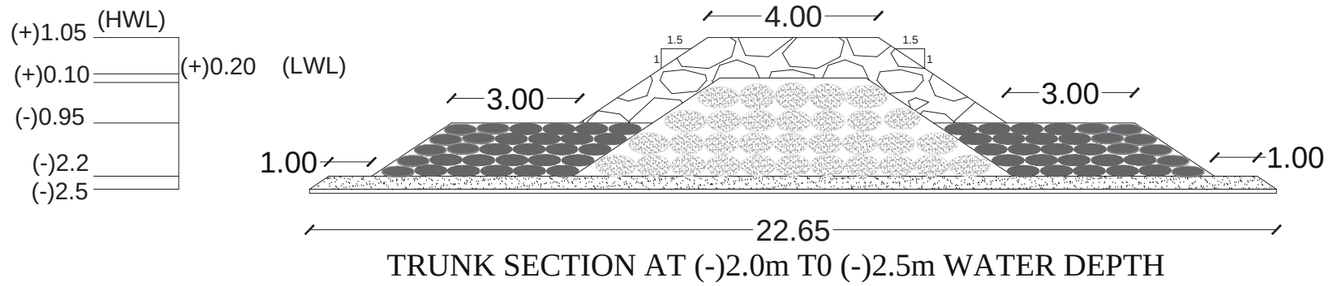
LEGEND:

HWL- HIGH WATER LEVEL
LWL- LOW WATER LEVEL

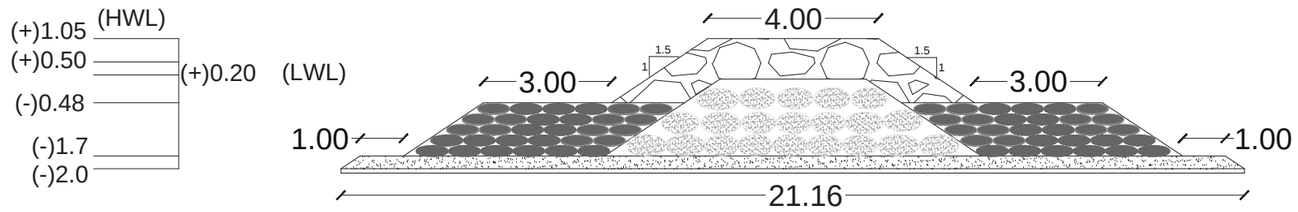
REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT.	SIGN. (CHECKED)	INIT.	SIGN. (APPROVED)

ORIGINAL SIZE:

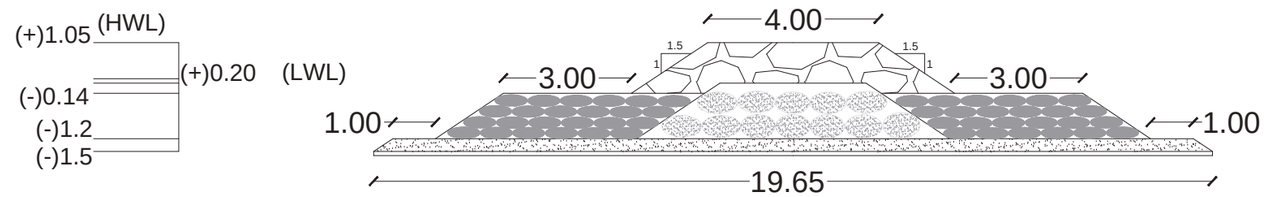
CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA	DATE 29.04.2022
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT	
DRAWING TITLE:	CROSS SECTION OF SUBMERGED GROYNES	
DRAWING NO:	15	
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ; Prof. V. SUNDAR; DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36	



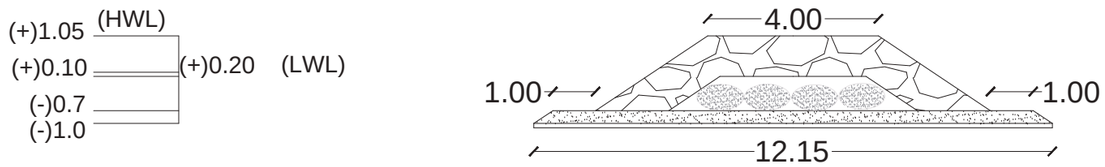
TRUNK SECTION AT (-)2.0m T0 (-)2.5m WATER DEPTH



TRUNK SECTION AT (-)2.0m T0 (-)2.5m WATER DEPTH



TRUNK SECTION AT (-)1.5m T0 (-)2.0m WATER DEPTH



TRUNK SECTION AT (-)1.0m T0 (-)1.5m
WATER DEPTH - UP TO HWL

ARMOUR LAYER, 1.5T to 2.5T of Stones at 0.95m Thick (70% of stones >2.0T)

TOE MOUND, Geo-bags at width 0.64m, height 0.25m, length 1m

Core layer, Geo-containers at width 0.8m, height 0.5m, length 1m (450-500kg of sand)

FILTER LAYER, 1kg-10kg at 0.3m Thick

GEOTEXTILE LAYER, 10mm Thick

Geo-containers at width 0.9m, height 0.5m, length 1.5m

Geo-bags at width 0.68m, height 0.32m, length 1.2m

NOTES :-

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. ALL LEVELS INDICATED ARE IN METERS WITH REFERENCE TO MENTIONED IN BATHYMETRY DATA

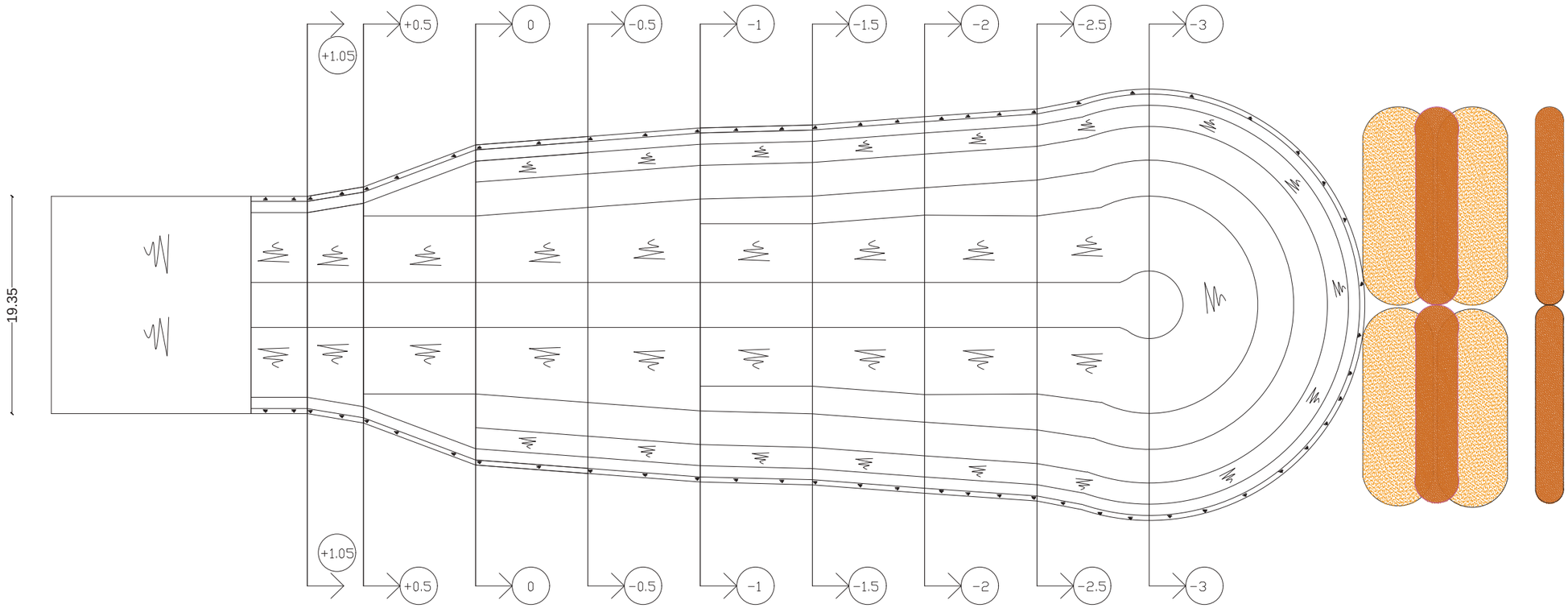
LEGEND:

HWL- HIGH WATER LEVEL
LWL- LOW WATER LEVEL

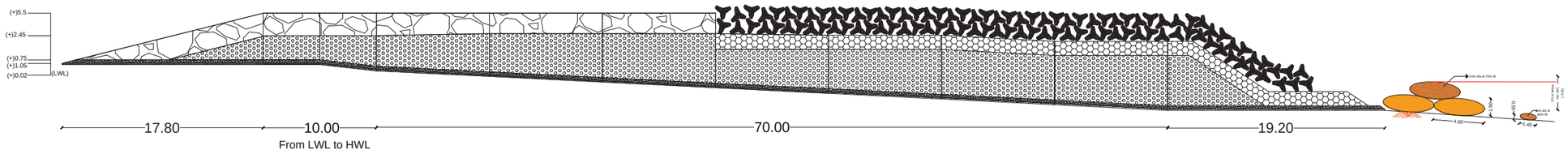
REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

ORIGINAL SIZE:

CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA	DATE 29.04.2022
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT	
DRAWING TITLE:	CROSS SECTION OF SUBMERGED GROYNES	
DRAWING NO:	16	
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ, Prof. V. SUNDAR DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36	



TYPICAL PLAN VIEW OF 70m GROIN



From LWL to HWL

LONGITUDINAL SECTION OF 70m GROIN

NOTES :-

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. ALL LEVELS INDICATED ARE IN METERS WITH REFERENCE TO MENTIONED IN BATHYMETRY DATA

LEGEND:

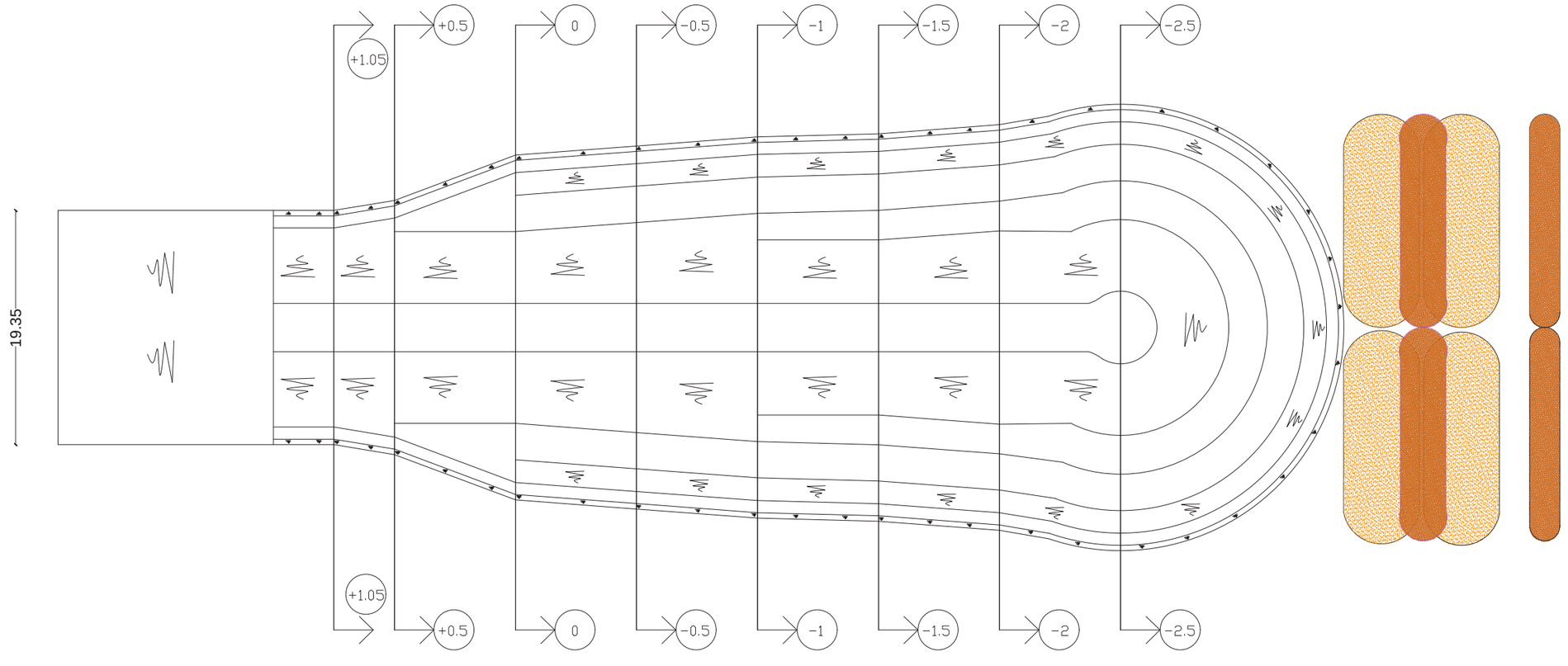
HWL - HIGH WATER LEVEL

LWL - LOW WATER LEVEL

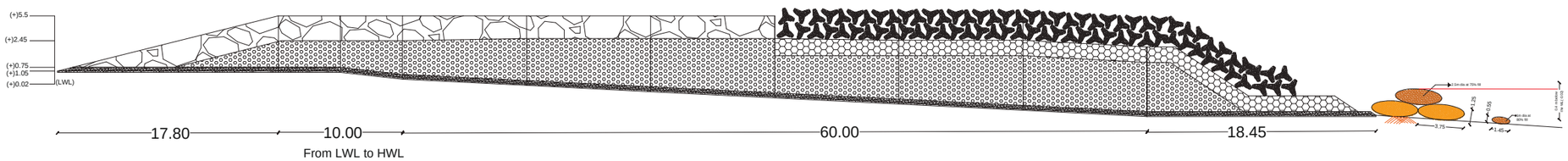
REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

ORIGINAL SIZE:

CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA	DATE 29.04.2022
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT	
DRAWING TITLE:	PLAN AND LONGITUDINAL VIEW OF SUBMERGED 70M T-GROYNE AT (-) 3.0m WATER DEPTH	
DRAWING NO:	17	
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ Prof. V. SUNDAR DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36	



TYPICAL PLAN VIEW OF 60m GROIN



From LWL to HWL

LONGITUDINAL SECTION OF 60m GROIN

NOTES :-

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. ALL LEVELS INDICATED ARE IN METERS WITH REFERENCE TO MENTIONED IN BATHYMETRY DATA

LEGEND:

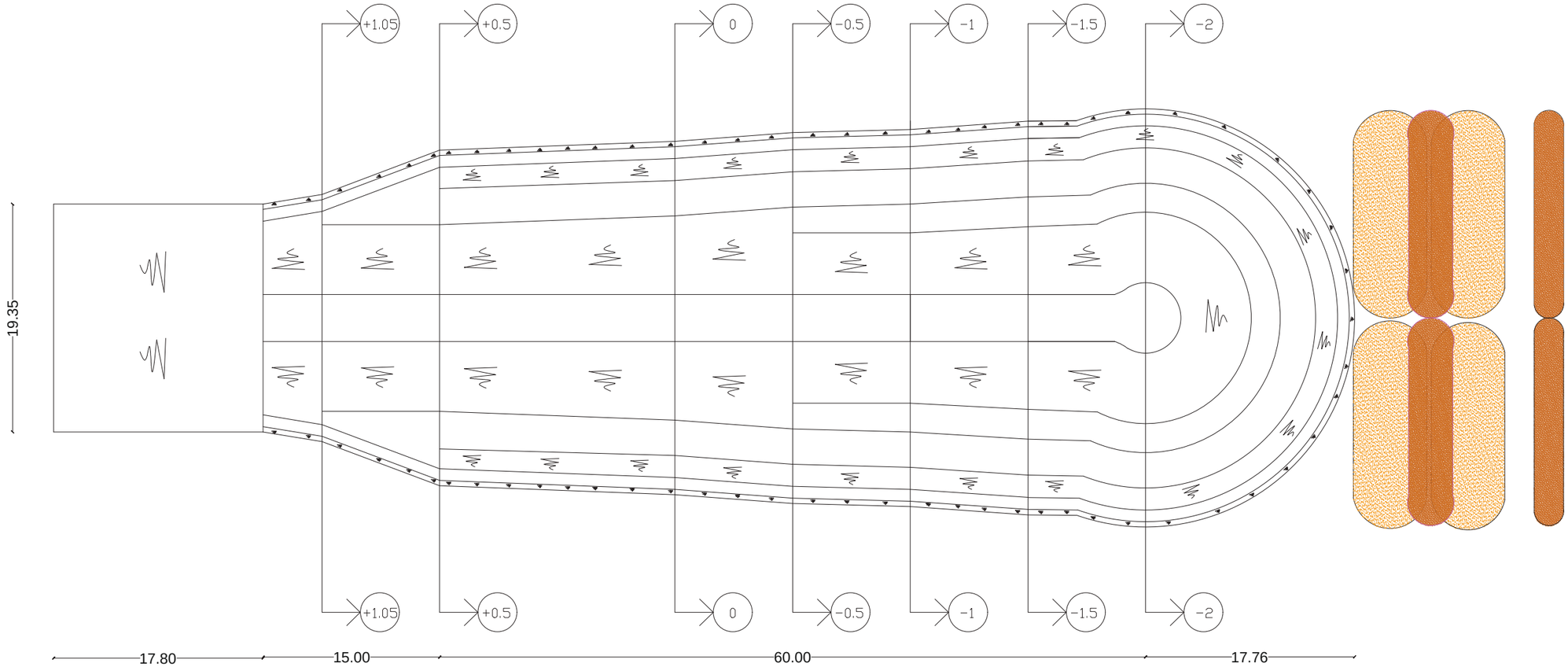
HWL - HIGH WATER LEVEL

LWL - LOW WATER LEVEL

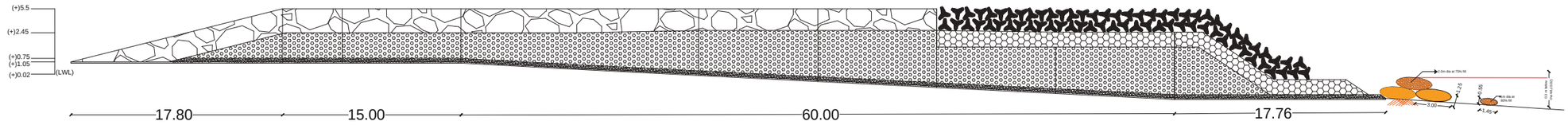
REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N .	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

ORIGINAL SIZE:

CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA	DATE 29.04.2022
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT	
DRAWING TITLE:	PLAN AND LONGITUDINAL VIEW OF SUBMERED 60M T-GROYNE AT (-) 2.5 m WATER DEPTH	
DRAWING NO:	18	
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36	Prof. V. SUNDAR



TYPICAL PLAN VIEW OF 60m GROIN



LONGITUDINAL SECTION OF 60m GROIN

NOTES :-

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. ALL LEVELS INDICATED ARE IN METERS WITH REFERENCE TO MENTIONED IN BATHYMETRY DATA

LEGEND:

HWL - HIGH WATER LEVEL

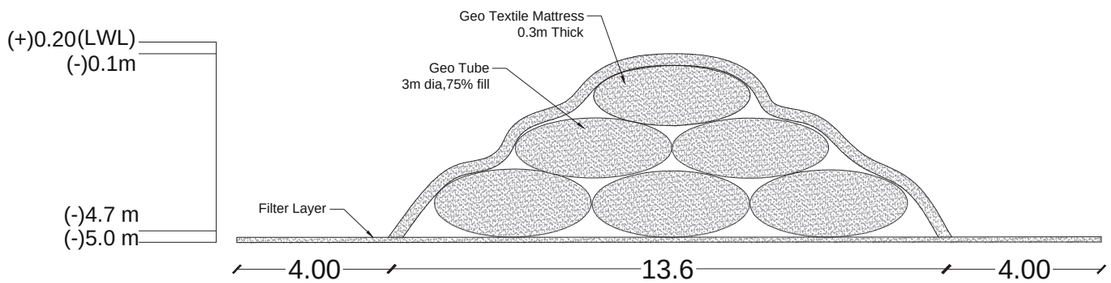
LWL - LOW WATER LEVEL

REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT.	SIGN.	INIT.	SIGN.
					CHECKED		APPROVED	

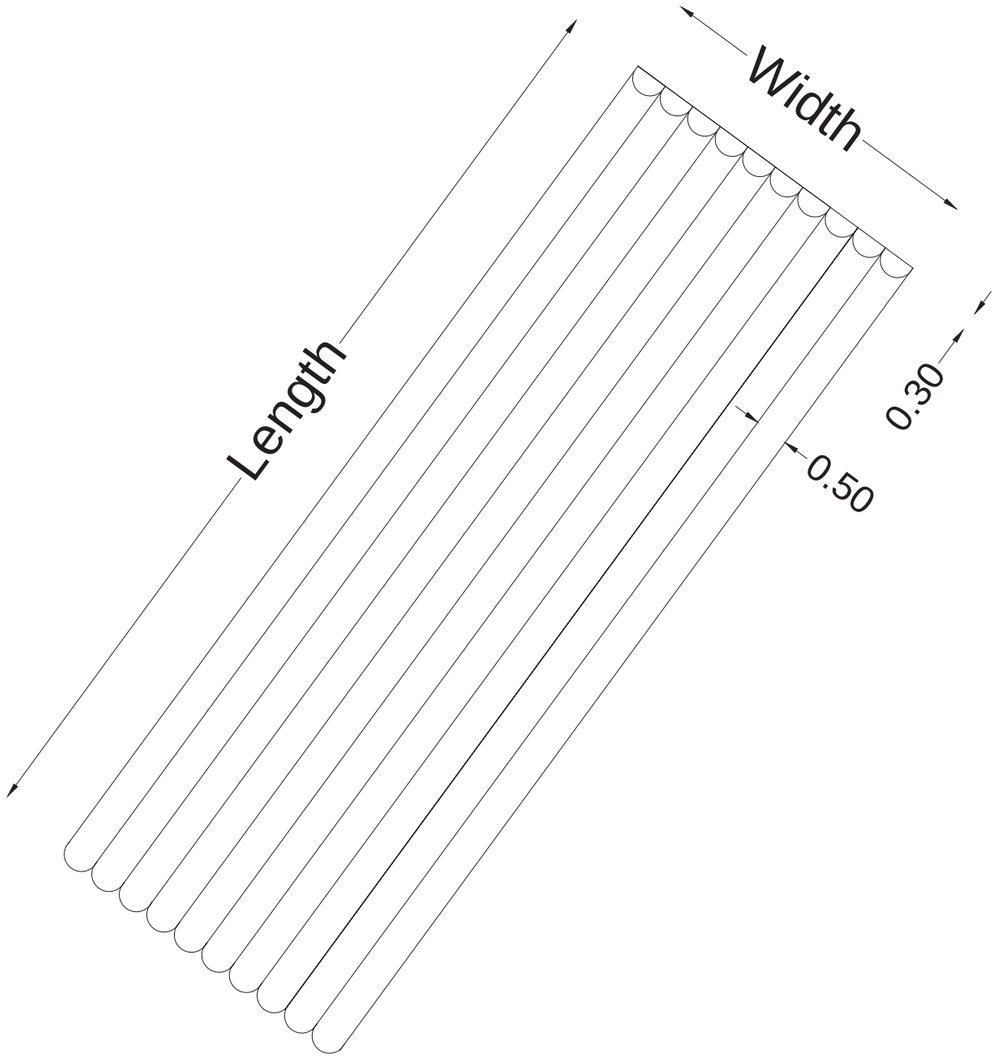
ORIGINAL SIZE:

CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT
DRAWING TITLE:	PLAN AND LONGITUDINAL VIEW OF SUBMERED 60M T-GROYNE AT (-) 2.0 m WATER DEPTH
DRAWING NO:	19
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ, Prof. V. SUNDAR DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36

DATE 29.04.2022



CROSS SECTION OF GEO-BAGS AT
(-)5.0m WATER DEPTH



GEO -TEXTILE MATTRESS

NOTES :-

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. ALL LEVELS INDICATED ARE IN METERS WITH REFERENCE TO MENTIONED IN BATHYMETRY DATA

LEGEND:

HWL- HIGH WATER LEVEL
LWL- LOW WATER LEVEL

REV.	DDMMYY / DATE	DRAWING NO:	TITLE	D R N	INIT. / CHECKED	SIGN. / CHECKED	INIT. / APPROVED	SIGN. / APPROVED

ORIGINAL SIZE: A

CLIENT:	KERALA STATE COASTAL AREA DEVELOPMENT CORPORATION LIMITED (KSCADC) & GIDA	DATE 29.04.2022
PROJECT:	SHORE PROTECTION WORKS FROM VYPIN TO MUNAMBAM STRETCH IN THE COASTAL AREA OF ERNAKULAM DISTRICT	
DRAWING TITLE:	CROSS SECTION OF GEO-TUBES, TYPICAL GEO TEXTILE MATTRESS	
DRAWING NO:	20	
ENGINEERING FIRM:	Prof. S. A. SANNASIRAJ / Prof. V. SUNDAR DEPARTMENT OF OCEAN ENGINEERING,IIT MADRAS, CHENNAI - 36	