

1. ORGANISATIONAL SET UP

The Kerala Engineering Research Institute is under the Directorate of Fundamental & Applied Research, KERI, Peechi headed by the Director in the rank of Superintending Engineer with, two Divisions functioning at Peechi, i.e., the Hydraulic Research and the Construction Materials & Foundation Engineering Division and another division namely the Coastal Engineering Field Studies Division at Thrissur, each headed by a Joint Director, an officer in the rank of an Executive Engineer.

The Directorate Institute is under I.D.R.B of Water Resources Department under the Chief Engineer, Investigation & Design (IDRB), Thiruvananthapuram.

The organizational set up of each Division is as follows:

I. Joint Director, Hydraulic Research

1. Hydraulics Division
2. Sedimentation Division
3. Coastal Engineering Division

II. Joint Director, CM&FE

1. Construction Materials Division
2. Soil Mechanics and Foundations Division
3. Instrumentation Division
4. Publications Division

III. Joint Director, Coastal Engineering Field Studies

1. Coastal Erosion studies Subdivision, Kozhikkode
2. Coastal Engineering Studies Subdivision, Ernakulam
3. Coastal Engineering Studies Subdivision, Kollam

These divisions are doing to research works, laboratory testing and collection of field data related to their respective fields and present valuable results and also analyses results having significant implications in different fields of Civil Engineering and Water Resources Management. Each subdivision has a Deputy Director in the rank of

an Assistant Executive Engineer as its head and one or two Assistant Directors in the rank of Assistant Engineer to assist in the research activities.

The Quality Control wing attached to this Directorate has been constituted for the purpose of quality assurance of works of Irrigation Department. The jurisdiction of this wing is all over Kerala. There are two Divisions one at Thrissur and the other at Kottarakkara, nine Subdivisions at Kannur, Kozhikode, Palakkad, Thrissur, Moovattupuzha, Kottayam, Alappuzha, Kottarakkara and Thiruvananthapuram and 18 sections, at Thiruvananthapuram, Kollam, Kottarakkara, Pathanamthitta, Allappuha, Idukki, Kottayam, Aluva, Moovattupuzha, Koothattukulam, Angamaly, Thrissur, Palakkad, Malappuram, Kozhikode, Kalpetta, Kannur and Kasargod.

2. PERSONNEL

The Executive officers who headed the various offices under KERI during the financial year 2016-2017 are:

DIRECTOR, FUNDAMENTAL & APPLIED RESEARCH	:	Er. Jessy Ann Francis (JD, CM&FE, KERI(FAC) from 01/04/16to 28/07/16)
	:	Dr. A. Udayakumar from 29/07/2016 onwards
JOINT DIRECTOR, CM&FE	:	Er. Jessy Ann Francis
JOINTDIRECTOR, HYDRAULIC RESEARCH	:	Er. Francis L. (from 1/04/16 to 25/08/16 FN)
	:	Er. K. Radhakrishnan (from 25/08/16 FN onwards)
JOINT DIRECTOR, CEFS	:	Er. K.L. Thomas
DEPUTY DIRECTORS		
CONSTRUCTION MATERIALS DIVISION	:	Er. Jaicy Joseph Palayakkara
SOIL MECHANICS AND FOUNDATIONS DIVISION	:	Er. Jaicy Joseph Palayakkara (from 1/04/2016 upto 06/09/2016 AN)
	:	Er. Geetha E.S (from 7/09/2016 FN onwards)
INSTRUMENTATION DIVISION	:	Er. Sheeja A Andezhathu.
PUBLICATIONS DIVISION	:	Er. Laila N.R. (from 1/04/16 to 17/09/16)
	:	Er. Sujatha.P (from 19/09/2016 to 18/02/2017)
	:	Post Abolished
HYDRAULICS DIVISION	:	Er. Sudha. M.S. (upto 18/02/2017FN)
	:	Er. Sujatha.P (from 18/02/2017FN onwards)

SEDIMENTATION DIVISION	:	Er. Shini K.K.
COASTAL ENGINEERING DIVISION	:	Er. C.K.Jagadambika(from 01/04/16 upto 8/09/2016) Er. Saji Samuel(from 09/09/2016 onwards)
C.E. SUB DIVISION, KOZHIKODE	:	Er. Shyla Begum.J
C.E. SUB DIVISION, ERNAKULAM	:	Er. Sandhya.T
C.E. SUB DIVISION,KOLLAM	:	Er. Radhalakshmi N.R.
ASSISTANT DIRECTORS		
F & A.R. (DIRECTORATE)	:	Er. Deepa. R.
CM & FE		Er. Saju Varghese
HYDRAULIC RESEARCH	:	Er. Joy. C. C.
COASTAL ENGG.FIELD STUDIES	:	Er. Anitha B. Nair
INSTRUMENTATION SECTION	:	Er. Saju Varghese (full additional charge)
CONSTRUCTION MATERIALS DIVISION	:	Er. Sufeera O. B (from 01/04/2016 up to 30/07/2016) Er. V. R. Valasalakumary (full additional charge from 01/08/2016 up to 01/11/2016) Dr. Santhoshkumar P.T (from 02/11/2016 up to 31/03/2017)
		Er. V. R. Valasalakumary (from 01/04/2016 up to 31/03/2017)
SOIL MECHANICS & FOUNDATIONS DIVISION	:	Er. Geetha E.S. from 1/04/2017 to 6/09/2016 Er. Miny T.M, Assistant Director I & II (FAC from 07/09/2016 FN to 31/01/2017AN and from 16/02/17 onwards)
PUBLICATION S DIVISION	:	Er. Miny T. M. (from 1/04/2016 to 6/02/2017 – post abolished)
HYDRAULICS DIVISION	:	Er. Ajithkumar T.V. (from 01/04/16 to 31/01/17) Er. Miny T.M. (from 01/02/2017 onwards)
SEDIMENTATION DIVISION	:	Er. Joy .C.C
COASTAL ENGINEERING DIVISION	:	Er. Divya .C.J. Er.Snisha T.B.
C.E.S. SECTION, KOZHIKODE.	:	Er.SivadasanA
C.E.S. SECTION,THALASSERY	:	Er.Pradeep Kinathi(from 1/4/2016 to 3/1/2017) Er. AnilKumarP. (from 03-01-2017 onwards)

C.E.S. SECTION, PARAPPANANGADI	:	Er. Girishkumar K
C.E.S. SECTION, ERNAKULAM	:	Er. JishaA.
C.E. SECTION, CHERTHALA	:	Er. Clament Roy. K.R
C.E. SECTION, CHAVAKKAD	:	Er. Suma.P.B (from 01/04/2016 to 7/03/2017)
		Er. Jisha. A (from 08/03/2017 onwards in charge)
C.E. SECTION, KOLLAM	:	Er. Kumari Anitha.L
C.E. SECTION, THOTTAPPALLY	:	Er. Ujin J.
C.E. SECTION, TRIVANDRUM	:	Er. Shibu K. Chacho

3. HUMAN RESOURCES

The human resources of KERI comprise of both technical and nontechnical personnel. During its prime, majority of the engineers working in KERI were post graduates in different disciplines of Civil Engineering. The number of fundamental researches were carried out during the period, bear witness to this. KERI was well known all over India and abroad for the research works and experimental studies carried out in this institute, especially in the field of Coastal engineering. In the past three decades, no significant fundamental studies have been carried out and the labs have gradually degenerated to the status of mere testing centres.

At present, out of the twenty-four posts of Assistant Engineers, four posts are lying vacant. The number of supporting technical staff in the category of draftsman is just Eight against a sanctioned strength of twenty-five. In the workers category, as it happens to be a vanishing category, just two workers are available at present. Workers are hired on contract basis or on daily wages as per requirement.

However, a sincere and commendable effort is being made by the staff to take up all the projects assigned to it. The vacancy position of KERI is attached as Appendix – I.

4. FUNCTIONING OF THE INSTITUTE

The Kerala Engineering Research Institute consists of seven divisions functioning at Peechi as well as Coastal Engineering and Field studies division at Thrissur and Quality Control wing of the Irrigation Department. Generally, the activities of each division can be categorized as falling under Routine activities, Fundamental studies and Revamping and Modernization. The routine activities and fundamental studies conducted by each division are enumerated in this chapter.

A. HYDRAULICS DIVISION

A.1 Introduction

Studies on various problems in Applied Hydraulics, Irrigation Engineering and Flood Control are taken up by this division and propose solutions for the same. The work on major Irrigation and Hydro-Electric Projects in the state are undertaken only after doing model studies/research studies by this division on that project. The studies are conducted on a wide range of parameters related to spillways, sluices, chutes, energy dissipating arrangement, operation of gate, flow condition in tail-race, silt excluding arrangements, hydraulic behavior of canal structures, river training works etc. By these studies, we are able to provide hydraulically sound and economically viable solutions to various problems associated with projects. In addition, a Meteorological station is functioning at Peechi under this Division.

A.2. Activities for the year 2016-17

- Measurement of meteorological data and maintenance of a Meteorological Station at Peechi Dam site.
- Assessment of Land use pattern change in the ayacut area of any Irrigation Projects using ERDAS IMAGINE and satellite Imagery- up gradation of computer system and laptop to install ERDAS IMAGINE software.
- Renovation & Protection work of Notch calibration Tank situated in Model Area I
- Routine works of Hydraulics Division.
- Other routine works such as maintenance of Model Area 1 & Model Area 2.

A.2.1 Meteorological Station, KERI, Peechi

Weather observations are necessary to improve Meteorological services in the state and enhance the predictive capability of short and long-term information for weather forecasts and climatic changes. They are used for the real-time preparation of weather analysis, forecasts and severe weather warnings, for the study of climates, for local weather dependent operations (for example local aerodrome flying operations, construction work on land and at sea) for hydrology and agricultural meteorology and for research in meteorology and climatology.

The Meteorological Station under K E R I, Peechi is located to the west bank of Peechi Dam, near the Peechi House at a Latitude of $10^{\circ} 31' 30''$ N, Longitude $76^{\circ} 21' 59''$ E and height above MSL +96.03m.

The station is equipped with the instruments for measuring manually the weather



parameters namely Atmospheric Pressure, Temperature, Humidity, Rainfall, Evaporation, Wind speed, Wind direction and Bright Sunshine. As part of modernization, an automatic

weather station was installed in June 2014 and is collecting data in every 30 minutes. The above weather parameters are being collected from this station daily at 8.30AM manually.

A.2.1.1 Automatic Weather Station

Time series observations are vital to improve the understanding of weather dynamics and its variability. The Automatic Weather Station plays an important role in providing short term and long-term time series weather observations. Automatic weather station is

functioning in Meteorological Station since July, 2014 with Remote transmission facility and a Solar Panel for uninterrupted power supply.

The Automatic Weather station collects data related to Air Temperature, Air Humidity, Barometric pressure, Ultrasonic Wind speed, Ultrasonic Wind Direction, Global radiation and Precipitation using different sensors. A Data Logger which is part of the Automatic Weather Station is collecting data in every 30minutes and transferring it to a central server in every 2hours using multiple protocols. These data can be accessed via internet using a software HYDRAS. The data collected can be used to gauge current weather conditions and to predict weather forecasts like temperature high/low, cloud cover and the probability of precipitation.



Components of Automatic Weather Station

1. Ultrasonic Wind speed and Direction sensor & Compass
2. Global Radiation Sensor
3. Temperature, Humidity, Barometric Pressure Sensors
4. Rain Gauge Data Logger

ULTRASONIC WIND SPEED AND
DIRECTION SENSOR

RADIATION SENSOR

TEMPERATURE, HUMIDITY & PRESSURE
SENSORS

RAIN GAUGE



IP DATA LOGGER



A.2.1.2 Manual Weather Station

Measurements of meteorological data are done by the following instruments and the readings are taken every day at 8.30 am.

- Temperature – Max & Min Thermometers & Bimetallic Thermograph
- Relative Humidity – Psychrometer (Dry & Wet bulb) & Hair Hygrometer
- Rainfall – Standard Rain Gauge, Self Recording Rain gauge
- Evaporation – Land Pan Evaporimeter
- Wind Direction – Wind Vane
- Wind Speed – Cup Anemometer
- Bright Sunshine – Sunshine Recorder

Max, Min Thermometers and Psychrometer (Dry & Wet bulb)

The standard, recommended maximum and minimum thermometers are two separate thermometers mounted (in a near-horizontal position) in a special device. The unit of measurement is degree Celsius. Recorded maximum and minimum temperatures are the highest and lowest values occurring during a specified period of time, such as 24 hours.



Psychrometer

Bimetallic Thermograph

This is used for measuring & recording atmospheric temperature as a function of time on recording chart



Bimetallic Thermograph

Relative Humidity

Humidity measurements at the Earth's surface are required for meteorological analysis and forecasting, for climate studies, and for many special applications in hydrology, agriculture, aeronautical services and environmental studies, in general. They are particularly important because of their relevance to the changes of state of water in the atmosphere.

The instruments used for measuring humidity are Psychrometer (Dry & Wet bulb) and Hair Hygrometer. Dry and wet-bulb temperature measurements are taken to calculate relative humidity.

A psychrometer consists essentially of two thermometers exposed side by side, with the surface of the sensing element of one being covered by a thin film of water or ice and termed the wet or ice bulb, as appropriate. The sensing element of the second thermometer is simply exposed to the air and is termed the dry bulb. In the figure, the psychrometer is placed vertically on either side of the box shelter.

Relative humidity is found out from the calibration graph (relative humidity table) connecting dry bulb temperature and the difference between wet bulb temperature and dry bulb temperature. It is expressed in percentage.

Hair Hygrometer

The most commonly used hair hygrometer is the hygrograph. This employs a bundle of hairs held under slight tension by a small spring and connected to a pen arm in such a way as to magnify a change in the length of the bundle. A pen at the end of the pen arm is in contact with a paper chart fitted around a metal cylinder and registers the angular displacement of the arm. The cylinder rotates about its axis at a constant rate determined by a mechanical clock movement. The rate of rotation is usually one revolution per day. The chart has a scaled time axis that extends round the circumference of the cylinder and a scaled humidity axis parallel to the axis of the cylinder. The humidity scale is divided into 100 equal segments. Each segment corresponds to 1%. The cylinder normally stands vertically. So, humidity can be directly read from the recording chart.



Hair Hygrometer

Precipitation

Precipitation is defined as the liquid or solid products of the condensation of water vapor falling from clouds or deposited from air onto the ground. It includes rain, hail, snow, dew, rime, hoar frost and fog precipitation. The total amount of precipitation which reaches the ground in a stated period is expressed in terms of the vertical depth of water (or water equivalent in the case of solid forms) to which it would cover a horizontal projection of the Earth's surface. Snowfall is also expressed by the depth of fresh, newly fallen snow covering an even horizontal surface.

Precipitation is measured in millimeters. Precipitation gauges (or rain gauges if only liquid precipitation can be measured) are the most common instruments used to measure precipitation. Rain gauges are of two types standard rain gauge (non recording type) and self-recording rain gauge. Standard rain gauge consists of a collector placed above a funnel leading into a container where the accumulated water and melted snow are stored between observation times and the quantity is measured manually.



Standard Rain Gauge

Three types of automatic precipitation recorders are in general use, namely the weighing-recording type, the tilting or tipping-bucket type, and the float type.

In the float type rain gauge, the level of the collected rain water is measured by the position of a float resting on the surface of the water. This instrument is used as a recording rain gauge by connecting the float through a linkage to a pen that records on a clock driven chart.



Self Recording Rain gauge (float type)

Evaporation

The rate of evaporation is defined as the amount of water evaporated from a unit surface area per unit of time. Estimates of both evaporation from free water surfaces, from the ground and evapotranspiration from vegetation-covered surfaces are of great importance to hydrological modeling and in hydro meteorological and agricultural studies. For example for the design and operation of reservoirs and irrigation and drainage systems.

Land Pan Evaporimeter is used for measurement of evaporation and is measured in millimeters.



Land Pan Evaporimeter

Wind Direction & Wind speed

Wind observations or measurements are required for weather monitoring and forecasting, wind-load climatology, probability of wind damage and estimation of wind energy. It is taken at a fixed location using 2 parameters; wind speed and wind direction. Surface wind is usually measured by a wind vane and cup or propeller anemometer. Wind Vane is used to find the wind direction and it is measured in

degrees clockwise from north. Cup anemometer is used to find the wind Speed and is measured in kilometers per hour.



Wind Vane

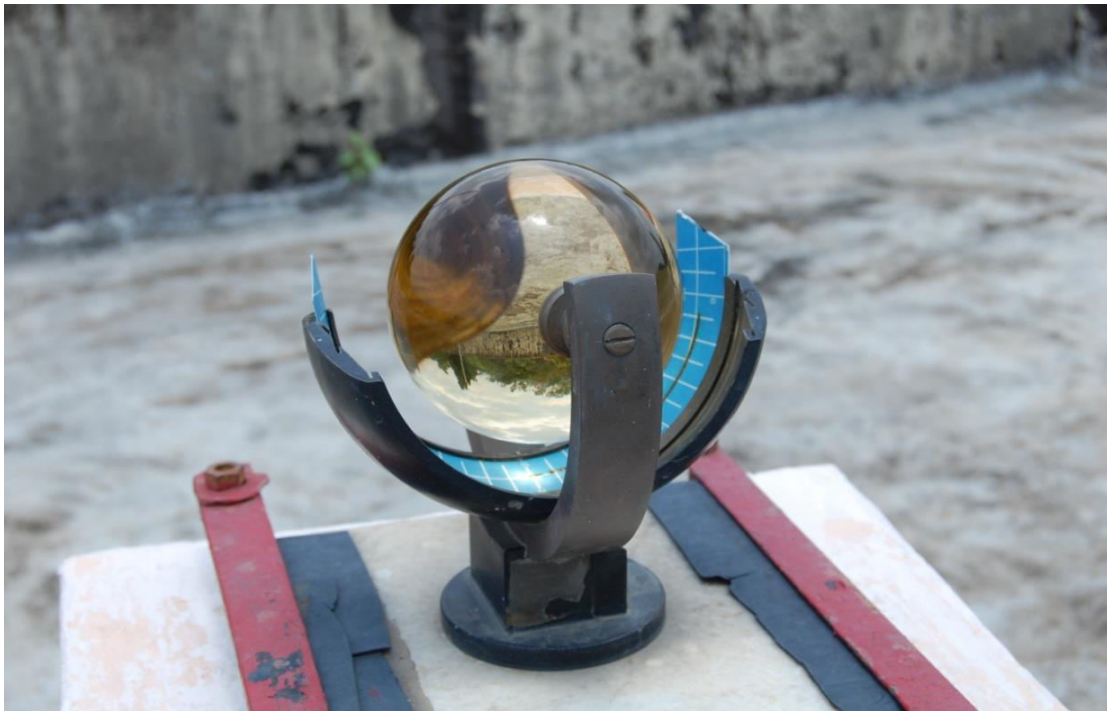


Cup anemometer

Bright Sunshine

Sunshine duration or sunshine hours is a climatological indicator, measuring duration of sunshine in given period for a given location on earth. An important use of sunshine duration is to characterize the climate of sites, especially of health resorts. It is often used to promote tourist destinations. For the specific purpose of sunshine duration recording, Campbell-Stokes sunshine recorders are used, which use a spherical glass lens to focus the sun rays on a specially designed tape. When the intensity exceeds a pre-determined threshold, the tape burns. The total length of the burn trace is proportional to the number of bright hours.

Duration of sunshine is in hours per day.



Sunshine Recorder

B.COASTAL ENGINEERING DIVISION

B.1 Introduction

Coastal Engineering Division was established for the purpose of conducting research works on behavior of Kerala Coast. This division has been started functioning from the beginning of the institute itself. Several research works on coastal protection measures, experimental study of wave run up on beaches, experiments to evolve suitable artificial blocks, study on mud banks, wave action on beaches, waves and currents, littoral drifts, artificial nourishment etc., had been conducted by this division. The model study of fishing gaps, design of fishing harbours like Mopla bay, Ponnani, Vizhinjam etc., were also conducted by this division during 70's and 80's. Collection of wave data and observation of beach characteristics have been carried out at several stations along the Kerala coast in the new moon day of all month for assessing the changes of Kerala Coast over years. Among these stations, observations at two stations i.e., at Padinjare Vemballore and Anchangadi in Kodungallur Taluk used to be carried out by this division till December, 2013.

As a part of modernization of Kerala Engineering Research Institute (KERI), a Smart Station from Leica Geosystems has been purchased in the financial year 2013-14 which is a new revolutionary surveying system in which high performance Total Station (TS11) and a powerful GNSS Receiver (GS14 satellite receiver) are perfectly integrated. The main components of Smart Station are Base station GNSS and Smart Antenna, RTK Rover GNSS with Pole, Antenna and CS10 Field Controller (Smart Pole) and Total station with back sight Tripod kit. For the fast progressing of survey, one more Smart Pole has been purchased during this financial year 2016-17. Presently this division is engaged in conducting topographical survey works for investigations related to Kerala Irrigation Department.

The works carried out by this division under the action plan for the financial year 2016-17 can be grouped under three categories.

I. Fundamental studies using Smart Station – All topographical survey works related to Kerala Irrigation Department carried out using Smart Station has been included in this category.

II. Routine activities of the Coastal Engineering Division – The works under this category include maintenance of the division office including maintenance of computers, purchase of essential furniture, consumable office supplies, small repair works to division office etc., maintenance of Director's and Joint Director, Hydraulic Research's Office including maintenance of computers, purchase of consumable office supplies etc., and maintenance of an outdoor model area which was used for physical model studies on Kerala Coast in past years.

III. Revamping and modernization of the Coastal Engineering Division – Any purchase of new instruments or upgradation of existing ones will be included under this category.

Apart from the works carried out in action plan of financial year 2016-17, an additional work Survey of Chandragiri River in Kasaragod District using smart station (Phase II) has also been carried out under the investigation fund of IDR. Phase I of this survey had been conducted by this Division during the financial year 2015-16.

The highlights of works taken up by this division during the year 2016-17 are as follows:

I. Fundamental Studies using Smart Station

1. Conducting investigation using Smart station for determining the current profile of Chulliyar Dam.

The main aim of this study was the determination of current profile of Chulliyar Dam and preparation of layout drawings of dam and premises including preparation of a 3D view of the dam. The highlights of the execution of survey and its outcomes are as follows:-

- A permanent benchmark had been established at the top of the rest house near dam.

- The position (latitude and longitude) of the benchmark was determined by setting the GS14 base station in static mode and processing the values received via satellite signals.
- The altitude of the point had been determined by connecting it with the MWL mark near the dam.
- The survey of dam and the premises had been progressed based on this benchmark value.
- Total area surveyed is around 89 acres.
- A layout of Dam and premises has been prepared
- A 3D view of the dam had been prepared.

2. Investigation of Bharathappuzha River Basin

Two investigation surveys at two different locations of Bharathapuzha River Basin had been carried out under this work as per the request from project authorities. They are

- Survey of Upstream side of Chamravattom Regulator cum Bridge for a study for establishing causes piping at RCB at IIT, Delhi.
- Survey for assessing storage capacity of regulator under construction at Changanamkunnu and finding out the possibility for a new Check Dam between Cheruthuruthy and Changanamkunnu.

At Chamravattom, survey had been conducted to find out the cross sections at 5m, 20m, 50m and 100m upstream side of regulator as per the requirement of IIT. Contour plan and cross sections has been plotted. A survey at downstream side of the regulator for a length of 1km had been carried out by this division during the year 2015-16 for the same study.



Survey had been conducted for 10km length in Bharathapuzha River Basin between Cheruthuruthy Bridge and newly constructing Changanamkunnu Regulator for assessing the storage capacity of regulator under construction and helping the project authorities to assess the possibility of a new check dam in this area. Survey had been carried out at 100m interval for 6.7km starting from regulator towards upstream i.e., till the end of storage back up and at 200m for the balance length till Cheruthuruthy Bridge. Contour plan and cross sections had been plotted.



3. Other Investigation works using Smart station

This work had been proposed for executing emergency works related to topographical surveys in the department which were not conceived during the commencement of financial year. Various works executed are:

- 3a. Investigation survey at downstream side of Thrithala Regulator cum Bridge till the end of apron requested by IDR B for suggesting rectifications of the cracks seen on the apron, bed level depletion and detachment of precast piles from the apron.
- 3b. Transferring the known benchmark at Peechi Dam to known benchmark at Thrissur Railway station (air distance 18km) with the use of GS14 satellite receiver by

setting intermediate base stations at Agricultural University, Vellanikkara and Field Studies Circle, Chembukkavu to study the possibility of transferring benchmarks without taking fly levels. A difference of nearly 23.8cm is noticed. Since both benchmarks at Peechi and railway station are not in the list of permanent benchmarks provided by Survey of India, there may be chance for error in either one of the BM or both.

3c. One more attempt is made to study the possibility of transferring benchmarks with the use of GS14 satellite receiver and without taking fly levels which is a time consuming task. The benchmark at Shornur Police Station is transferred to benchmark near National Highway at Kuttippuram (air distance 28km) by setting temporary stations at Minor Irrigation Section, Pattambi and a private building near Parudur Village Office. The BM values at both stations are provided by survey of India. A difference of around 1.9m is noted. Since the difference is more than the acceptable limits, this method cannot be accepted for transferring bench marks. We are planning for more suitable methods for transferring BM with the aid of satellites in the financial year 2017-18.

3d. The value of 5 Ground Control Points (GCP) is purchased from Survey of India to validate the latitude and longitude of points established by the Smart Station.



II. Routine activities of the Coastal Engineering Division for the year 2016-17.**II.1 Routine activities of the Coastal Engineering Division office**

This work has been included in the action plan for meeting the routine activities of this office and also for maintenance of the division office. Maintenance of computers, purchase of essential furniture & consumable office supplies, small repair works to division office etc., had been done in this year.

II.2 Routine activities of the office of the Director, F & AR and Joint Director, Hydraulic Research

This work has been proposed for meeting the various requirements of the offices of the Director, F&AR and Joint Director, Hydraulic Research for the routine activities. Maintenance of computers, purchase of consumable for both offices etc., had been done in this year.

II.3. Maintenance of the model area of the Coastal Engineering Division

A model area where physical model studies related to Kerala Coast had been conducted in previous years is maintained by this division. All works such as clearing the bushes, routine cleaning of model trays, overall upkeep of model sheds for keeping this area spick and span had been done.

III. Revamping and Modernization of the Coastal Engineering Division for year 2016-17.**III.1 Upgradation of existing Smart Station with additional rover and other accessories**

The Smart Station equipment which has purchased as a part of modernization of KERI in financial year 2013-14 has one base GPS unit which is set up at a known point termed as reference station and rover GPS which is a portable unit for progressing the survey. The position of rover GPS is relative to the position of the reference station. Multiple rover GPS units can be connected to a single base GPS unit and survey can be progressed fast. Since our division is engaged with lots of investigation works and some are of very urgent nature, one more rover GPS with control unit has purchased this year which enabled us speedy progress of survey.

IV. Additional works using Smart Station.

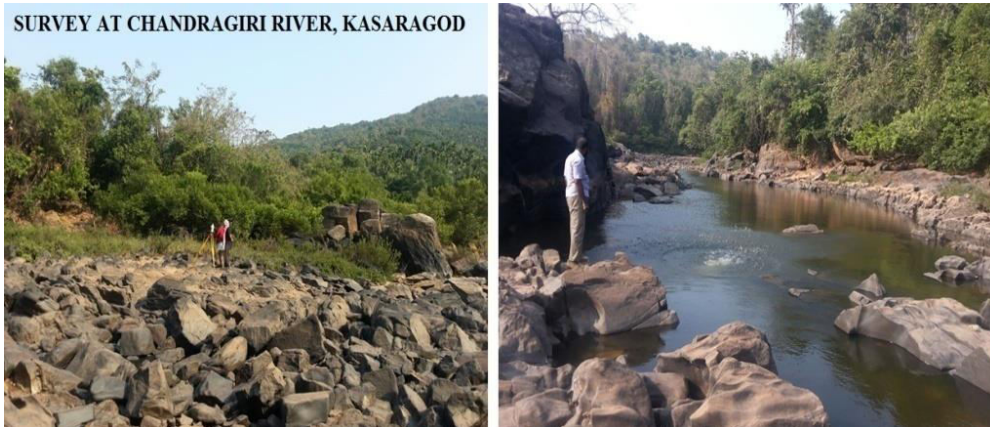
Survey of Chandragiri River in Kasaragod District using Smart station.

The main aim of the investigation of the river basin of Chandragiri river of Kasaragod District is to prepare basin maps for identifying suitable locations for construction of check dams and regulators. This investigation proposal is important in the light of reducing water crisis in Kasaragod area.

Technical Sanction for the survey of Chandragiri River at Kasaragod District was accorded by Director, F&AR as per T.S. No. 02/2015-16/DR/F&AR/KERI dated: 15/02/2016 for an amount of Rs.45 lakhs under the head of a/c:4700-80-005-99- Investigation of Irrigation Schemes. The proposal was for the survey of 105km of the river for an average width of 110m by taking c/s at 100m interval including the survey of both banks at the same interval for a width of 50m each.

The first phase of survey work had been started in February, 2016 and the survey of 19km of river having an average width of 130m, upwards from the railway bridge (i.e., approximately 1 km from sea mouth) had been completed in the financial year 2015-16. The total expenditure for Phase I was Rs.10,01,958/-. PhaseII of this work had been conducted in this financial year 2016-17. Survey of Payaswini Branch of Chandragiri River for a length of nearly 11km u/s of last year's work has been conducted for an amount of Rs.3,27,093/-. The survey of entire river will be completed in third phase in financial year 2017-18.

SURVEY AT CHANDRAGIRI RIVER, KASARAGOD



C. SEDIMENTATION DIVISION

C.1 Introduction

The Kerala Engineering Research Institute, (KERI) Peechi, one of the pioneering research institutions of its kind in our country, plays a vital part in fundamental and applied research studies in the field of Civil Engineering. KERI conducts studies and research in the field of Civil Engineering for the State Government, Quasi Government Institutions and Private Organizations. The institute also undertakes project funded by organizations like Central Board of Irrigation and Power (CBIP), Indian National Committee for Hydraulic Research (INCH).

Sedimentation Division, of KERI conducts studies to compute the present capacity of reservoirs and other water bodies. Such studies are conducted using modern electronic equipment called “Integrated Bathymetric System” (IBS). From 2004 onwards, KERI completed 29 studies with this IBS including Mullapaeriyar and Vembanad Lake. In order to ascertain the availability of water and to estimate the siltation a new equipment called Sub Bottom Profiler was purchased in 2003. As a pilot study using this equipment Peechi Reservoir was selected and six studies were completed till now.

C.2 Works carried out during 2016

C.2.1 Bathymetric Study of Kattampally Wetland in Kannur District Using Integrated Bathymetric System & Sub Bottom Profiler

The Director, CWRDM, Kozhikode had requested Kerala Engineering Research Institute (KERI) to conduct a bathymetric study of Kattampally wetland in Kannur District using Integrated Bathymetric system. This was a Deposit Work, KERI constituted a team consisting of

- | | | |
|----|------------------------|--------------------|
| 1. | Er. Udhayakumar | Director |
| 2. | Er. K.Radhakrishnan | Joint Director |
| 3. | Er. Shini K.K | Deputy Director |
| 4. | Er. Joy .C.C | Assistant Director |
| 5. | Sri. Francy .V. Antony | Research Assistant |

C.2.1.1 Equipments used

➤ Sub Bottom Profiler

The system SES-2000 sub-bottom profiler, which is a mobile parametric sediment sounder, was used for bathymetric and sub-bottom profiling survey. The SES-2000 hardware component and transducers are shown in Figure. The compact design with a user-friendly control unit allows the survey even in small and shallow waters with all the advantages of the parametric acoustics, viz., small beam width at low frequencies, deep penetration with high resolution of layers and objects, and accurate depth measurements with high frequency. The system offers the possibility to store data digitally and also gives reliable results during online data processing. The system is primarily designed for shallow geophysical surveys. The tolerance of the system for 100 kHz frequency is $0.02\text{m} + 0.02\%$ of water depth and for 10 kHz it is $0.04\text{m} + 0.02\%$ of water depth. The compact design without integrated industrial PC components results in an affordable and reliable instrument for sub bottom profiling applications.

Both the primary high frequency (HF) signal (100kHz) and the secondary low frequency (LF) signal (6–12kHz) are recorded. Penetration can reach up to 50m in soft sediments. Advantages of the parametric acoustic system include:

- (i) narrow beam width at low frequencies;
- (ii) deep penetration with high resolution of sediment layers and objects, and
- (iii) accurate depth measurements with the high frequency signal. The variant SES-2000 compact is designed for shallow water depth applications near the shore and inland waters down to 400m.



Top- side Unit



Transducer

➤ **Differential Global positioning system (DGPS)- Leica MX 9525**

(Reference Station) with UHF transmitter link along with choke-ring Antenna forms stationary part of DGPS. It can track up to 12 satellites to achieve accurate position.

➤ **NS-415 Echo-sounder.**

Navitronic Echo-sounder NS 415 is designed to measure under water depth up to 1200m. Accuracy of instrument is 1centimeter.

➤ **FRP Boat (mobile station)**

The mobile station setup is mounted on “Fibre Reinforced Plastic” (FRP) boat having two 60 HP petrol out board engines. The boat has dimension of 7.5m x 2.66m x 1.20m and 8 person capacity with the equipments.

C.2.1.2Data Collection System

The Data Collection system consists of a Laptop (DELL) loaded with Navisoft Survey software. The Navisoft survey module collects the depth data from the echo sounder which is linked with the position data. This is collected at every 100 meters interval and logged as “PRD” format data for further analysis. Navisoft is the software used to plan and collect the data for data processing, which runs in the laptop and collects data through serial port at 9600 baud rate.

C.2.1.3Software

❖ **Navisoft survey software**

This software is used for data collection and processing.

The Bathymetric software supports NMEA 0183 compatible devices. Local grid UTM (WGS-84) is the projection that is supported by the software.

❖ **Surfer software**

Surfer is a graphic program used for calculating the volume based on the logged data.

- ❖ **SESWIN for data acquisition in SES 2000**
- ❖ **I.S.E. 2.9.2 Post Processing Software**

C.2.2 Data Collection

The mobile station consisting of the GPS antenna, Echo sensor, UHF antenna is setup on FRP boat with help of mechanical fixture. Proper connections are done to the GPS, Echo sounder and to the Laptop. The transducer of sub bottom profiler was fixed with help of mechanical fixture connected at the left side of the boat, which will allow the sensor to collect true depth, and away from wave noises. The boat was sailed along the track, wherever possible maintaining a speed of 3 to 4knots. The depth of water and its corresponding position is recorded successively at each point. The software enables generation of depth profile and overviews using the data recorded. Figure shows the echo sounder along with the data being logged into the Laptop.

In this study, we used a new equipment the **SES-2000** parametric (non-linear) dual frequency echo-sounder. The instrument simultaneously transmits two signals of slightly different high frequencies; their interaction creates a new low frequency signal. It has a large bandwidth and a short signal length, which allows good use in very shallow water and results a high (~15 - 20cm) vertical resolution at acceptable sub-bottom penetration up to 10 m or more. Some favourable near sub-bottom seismic and geological conditions permit to achieve a vertical resolution up to 10cm. Parametric (non-linear) sound generation allows designing acoustical systems with small transducer dimensions and narrow sound beams at low frequencies. An Innomar SES-2000 parametric transducer has an active area of 20 by 20cm and provides a beam width of less than four degrees (at 3dB), valid for all adjustable low frequencies between 5kHz and 15kHz. The transmit directivity of the parametric sound beam does not show any significant side lobe characteristic, which reduces ambiguities during the interpretation of individual reflectors. Short transmit signals of single sinusoidal cycles without any ringing and high ping rates of up to 50pings per second are further advantages. They contribute to a high spatial resolution of this acoustical system and permit to apply it in a shallow basin. Innomar's software tool ISE provides near real-

time processing of the collected SES data. The operation procedure can be tuned on-line. A value of the sound velocity in water is used to convert sound travel time to the depth. The depth values are screened online. Some advantage of the SES-2000 parametric (non-linear) dual frequency echo-sounder is the survey of small water reservoirs, which often requires the collection of sub-bottom data from small boats in water depths of down to one meter and to resolve thin layers of recent sedimentation due to damming. Furthermore, the determination of near surface structures, e.g. shallow fault zones, is of interest at the same time and can be achieved with the application of such a mobile parametric profiler system.



Data Collection setup inside the Boat

Data Collection

C.2.3 Location

The Kattampally project area is situated at in the Kannur District.



Location map

C.2.4 History of the Project

This is the first major scheme proposed in this District, and has been designed as a multipurpose scheme of irrigation, prevention of salt water intrusion, Reclamation, flood control, Navigation and communication. The project was proposed to protect about 3168 acres of wetland from floods and salt water intrusion thus converting Kattampally into a three-crop area. The project put forward the possibility of near zero salinity in the water for the entire year and the prospect of growing three crops of paddy. It envisaged that the water required for the second and third crop of paddy would be supplied from the Pazhassi irrigation project through its canals. The river is nearly 13miles long and is winding in its course through the plains. Out of its length of 13miles, the river is affected by tidal action for a length of 8miles from its confluence with the Valapattanam river. The catchment area of the river is about 52Sq.miles and the maximum flood discharge will be about 13,950cusecs. The average tidal variations between low and high tide is 2.78ft. The project was started in 1958. The main aim of the project is to protect the lands from salt water intrusion and floods, thereby stabilizing the existing cultivation.

C.2.4.1 Kattampally River

The Kattampally river is a tributary of the Valapattanam river joining the main river round about Narath and Chirakkalamsons of Kannur Thaluk. Valapattanam River is major river starting from the Western Ghats. The Kattampally River has width of nearly 1225ft at the site proposed for the regulator. The maximum discharge in the river is completely small and investigation conducted have shown that the flood in the river is caused mainly by the backing up of flood waters from the Valapattanam river. The floods occupied with the tidal action of the Valapattanam River has widened the river course, flooding and submerging low lying lands and creating a back water called the “Kattampally Swamps”. A road bridge over the regulator was constructed for connecting the roads. The regulator covered about 186meters of the river. The remaining length was closed by an embankment with an all-weather road on top. The canalizing of the river through the regulator enabled reclamation of 1000 acres of the

swamp for paddy cultivation on the north side of the river. A navigation lock was constructed on the southern side of the regulator. The river is navigable and the boats, timber pontoons etc., can pass through the navigation lock. The lock has an electrically operated gate. Canals were built from Pazhassi dam to Kattampally to bring fresh water during periods of water shortage.



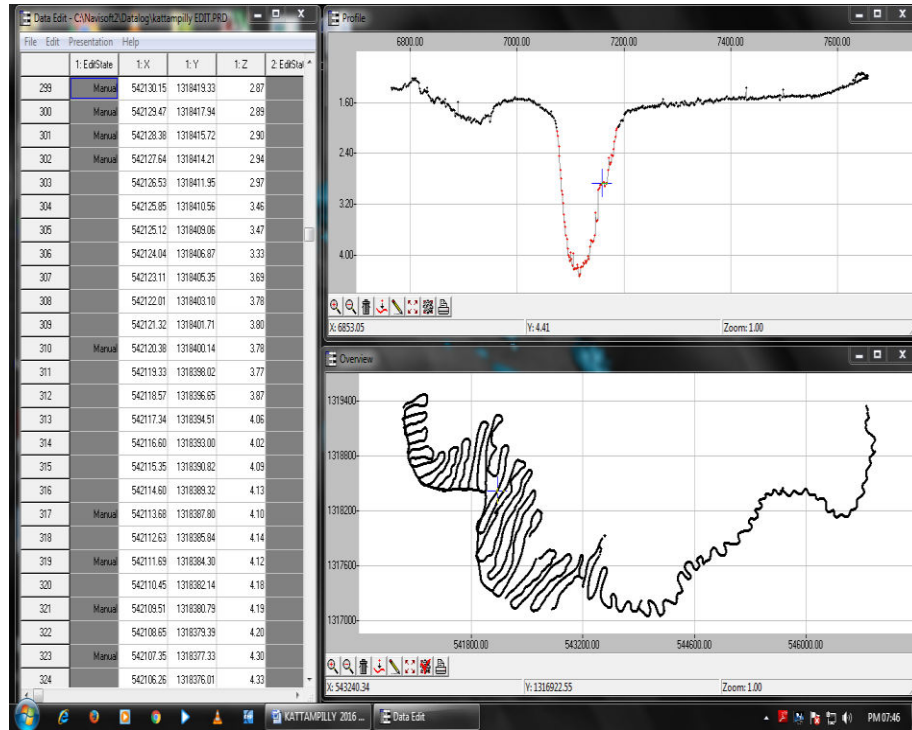
Kattampally Wetland

C.2.4.2 Hydrographic Survey

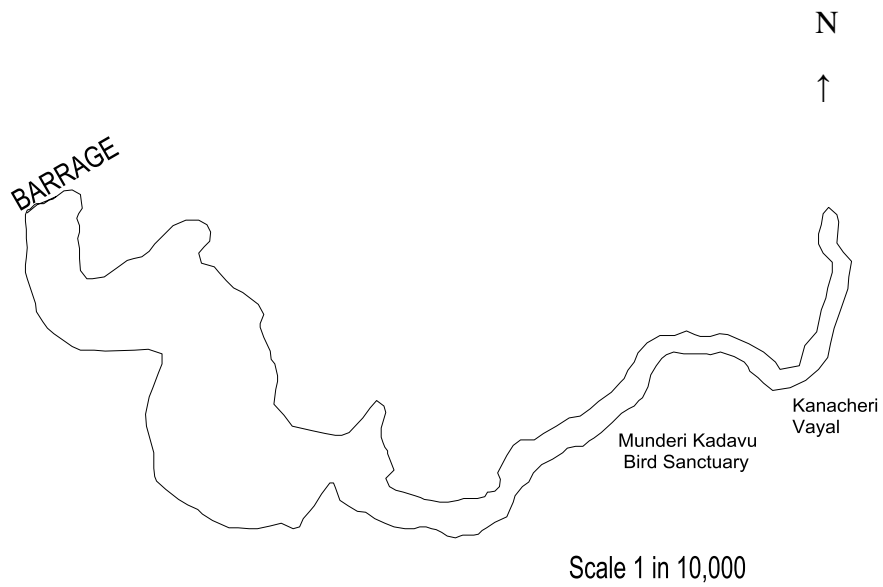
All the settings were done in the mobile station for the survey.

The Bathymetric survey of the Kattampally wetland portion reservoir was conducted on FRP out board boat and all electronic equipment was installed on the deck. Accurate positioning of the boat was reached using Global Positioning System (GPS). Using survey module planning and presentation was done by entering the position as UTM (Universal Transverse Mercator:- A special transverse Mercator grid which divides the world in to 6^0 zones of Longitude) co-ordinate, and drawn reference line, with respect to this reference line, parallel lines are drawn at an interval of 100m to cover the entire water spread area. The survey was conducted along the predetermined segment lines after setting the data logging software to record the readings at 2m intervals. The boat was sailed along the track maintaining a speed of 3 to 4knots. The depth of water and

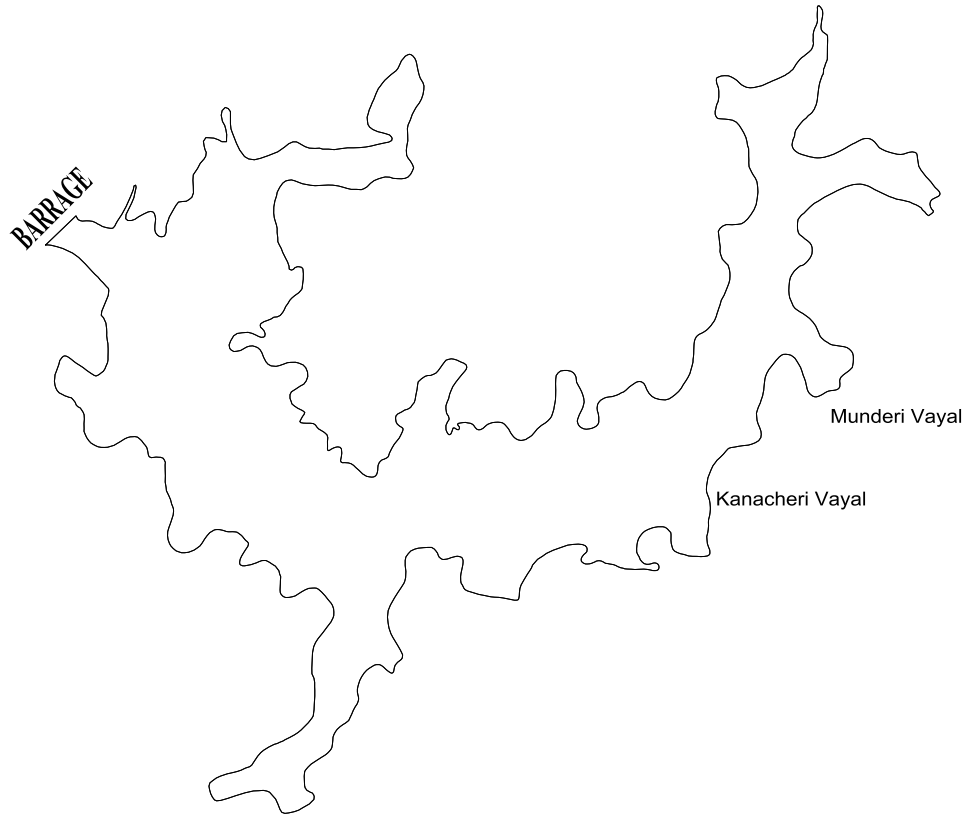
its corresponding position is recorded successively at each point. The software enables generation of depth profile and overviews using the data recorded. The data is then edited to eliminate spurious readings caused due to violent winds and waves.



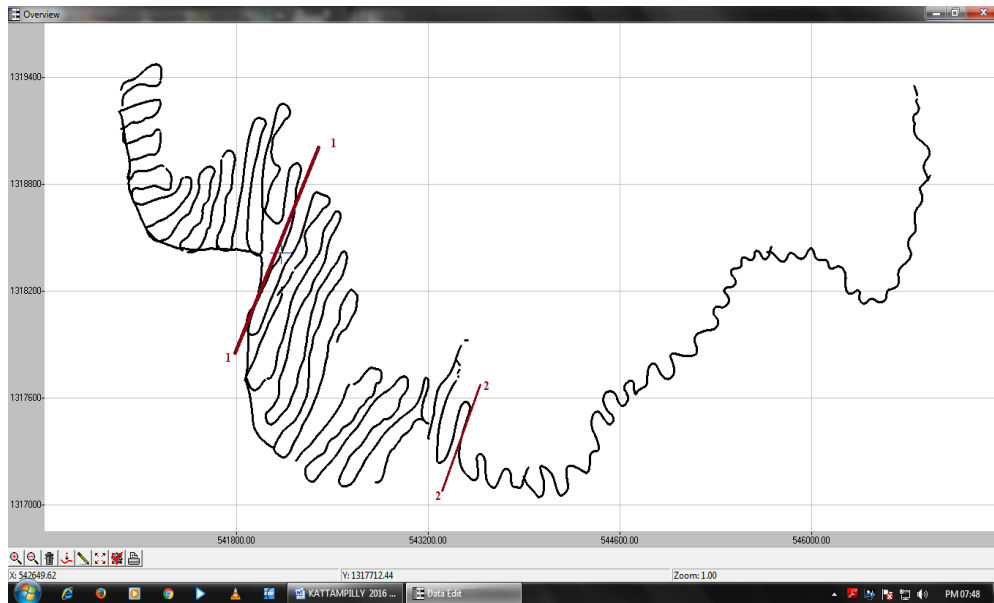
Data collection in IBS



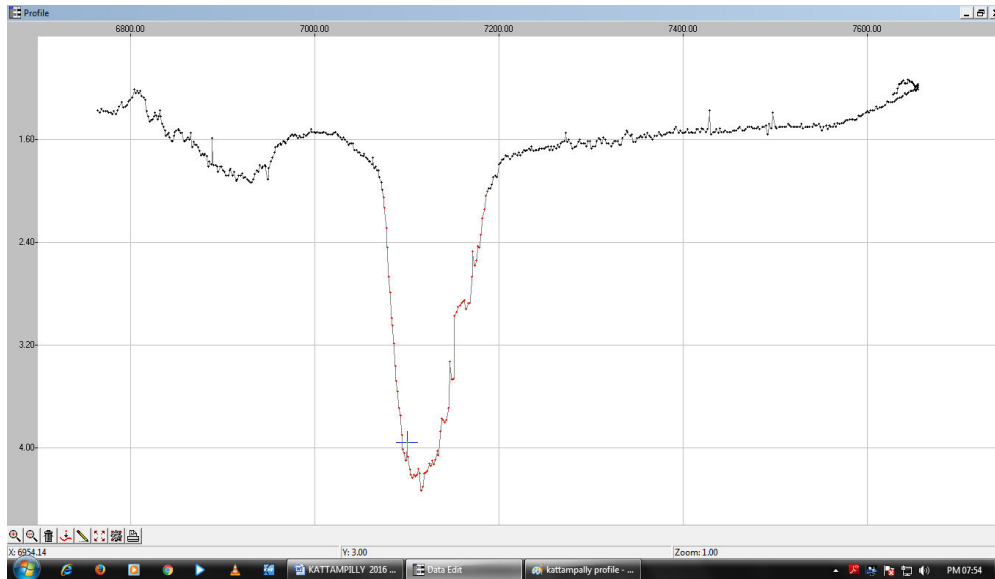
FRL Map of Kattampally Wetland (surveyed portion)



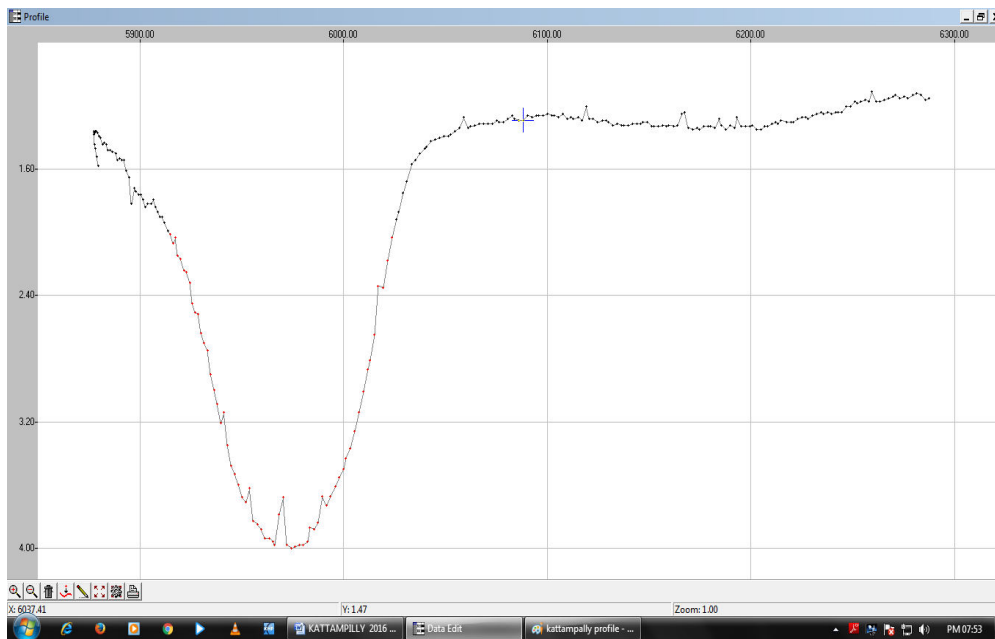
FRL Map of Kattampally Wetland



Plan of Kattampally Reservoir showing sections surveyed



Profile 1-1 E (541874.32 ,542230.40), N (1318024.64, 1318914.11)



Profile 2-2 E(543533.79, 543503.51), N (1317137.23, 1317547.64)

C.2.4.3 Estimation of Capacity

The water Spread area of the surveyed portion at water level 1.5m is estimated as 2.94Sq.km and the corresponding volume is 6.547Mm³.

The survey could not be carried out through the entire portion due to low water level, hindrance of Mangroves, existing damaged bund road etc. From the geo referenced

topo sheet of whole area of wetland, the corresponding area is 15.32Sq.km and approximate depth has been given to 0.4m to 0.9m for the non-surveyed portion, the volume at this water level is estimated as 15.466Mm³.

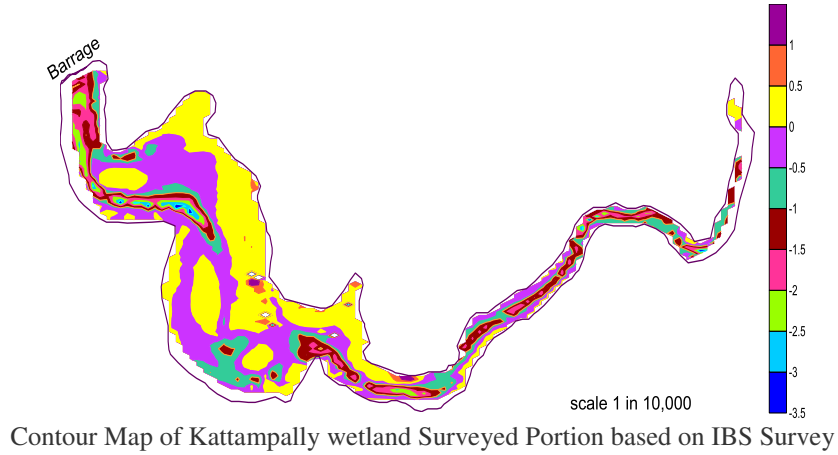
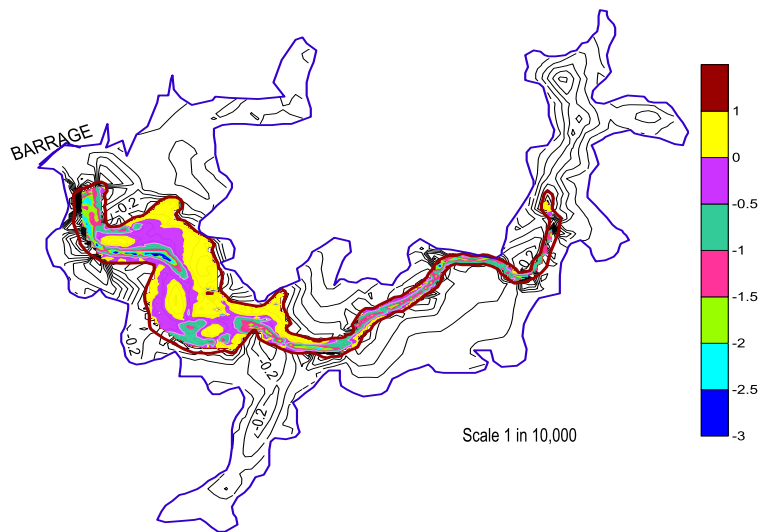


Table-1 Present capacity of the Wetland

Level (m)	Capacity (Mm ³)	Area (Sq.km)
1.5	15.466	15.32



○ Non surveyed portion
Map of Kattampally Wetland

C.3 Conclusion

The bathymetric survey of Kattampally wetland portion was conducted from 17th October, 2016 onwards and was completed by 25th March, 2016. Results of Bathymetric survey has been reported herein.

Routine activities such as maintenance of departmental jeep, boat and office computers has been done.

Purchased a new Hydrographic software Qincy.

D.CONSTRUCTION MATERIALS DIVISION

D.1 Introduction

Construction Materials Division, functioning in K.E.R.I, Peechi is basically a material testing laboratory. In addition to conducting routine tests on building materials, the division has developed the capacity for conducting fundamental and applied research in related fields. This division takes up consultancy work such as concrete mix design and projects from clients. This division also imparts training for laboratory staff on request.

This lab is equipped with Rebound hammer, Rebar locator and Ultra sonic pulse velocity meter & core cutter. These nondestructive tests are being conducted to check the strength and deformation characteristics of the structure.

Two hundred and Ten test reports were produced from this division during this financial year 2016-2017 year earning a revenue of Rs.11,97,000/- (Rupees eleven lakh ninety-seven thousand only).The materials were brought by various government as well as private entities. Materials involved in testing were cement, concrete, bricks, rocks, tiles, paver blocks, aggregates and steel. This Division also involved designing of concrete mixes for private and Government agencies. Using core cutter, cores were taken and strength determined for the work “Deck slab of Illikulam Railway thodu in Karipuzha”, Kayamkulam and for the “Aqueduct at Kuttiyadi Irrigation Project.”

Apart from these, a fundamental study was conducted on the reliability of accelerated curing method for speedy design of concrete mixes.

D.2 Tests Conducted

Details of tests conducted during the year 2016-17 are given in Appendix-III.

E. SOIL MECHANICS AND FOUNDATIONS DIVISION

E.1 Introduction

Soil, the most unpredictable of all engineering materials, also happens to be the most important material in civil engineering because all structures need to be founded on earth. In addition to being the founding medium, soil is also used as a material for construction. As in the case of other materials, properties of soil cannot be generalized since basically soil is a combination of different constituents having different properties. Therefore the study of the technical and structural aspects of soil is of great importance.

Major difficulties encountered in foundation work are due to the nature of soil. The investigation for any foundation engineering problem may range from a simple examination of soil to a detailed study of the soil and ground water by means of bore holes and laboratory tests on the materials encountered. The extent of the work depends on importance and foundation arrangement of structures, the complexity of the soil conditions and already available information of existing foundations on similar type of soils.

The physical characteristics of soils can be investigated by means of laboratory tests on samples taken from boreholes or trial pits. Results from lab tests can be used to derive important parameters in the design of substructure. The results of shear strength tests can be used to calculate the ultimate bearing capacity. Soil parameters so obtained by means of investigations can be utilized to design safe structures.

Soil Mechanics Laboratory under K.E.R.I. is fully equipped to determine the index as well as the engineering properties of soil samples and the engineers in charge are trained to provide recommendations on structural details if necessary. It covers Soil Mechanics, Soil Dynamics, and Ground improvement Techniques. The soil mechanics laboratory undertakes work from Government as well as private agencies.

Analysis of engineering problems such as bearing capacity computations, settlement analysis, stability analysis of slopes etc., are taken up by this Division. Instrumentation and analysis of seepage data from various Irrigation Projects are also taken up.

The work is divided into the following stages.

E.1.1 Pre-Construction Stage

During investigation, the soil samples are collected and tested in the laboratory, for finding out index properties and engineering properties like MDD, OMC/FMC, Permeability, Shear parameters, Consolidation and Swelling characteristics and relevant parameters are furnished to design the proposed structures. The laboratory is assisted by the Instrumentation Division which is equipped with field equipment for boring to collect undisturbed soil samples. Field tests like Plate Bearing Test, Standard Penetration Test, and Dynamic Cone Penetration Test to assess the in-situ characteristics of sub-soil are also carried out.

E.1.2 Post Construction Stage

Measurement of seepage through earth dam, inspection and investigations of causes of slips and breaches of canal, dam and embankments are taken up and remedial measures are suggested.

All the tests on soil samples received from various projects of Irrigation Department, Roads and Buildings, Panchayat Raj, Public Health, Kerala

State Electricity Board, Housing Board and Non-Government Agencies are being tested as per the Bureau of Indian Standards.

E.2 Infrastructure

The important equipments available in the laboratory are

- i) Direct Shear Test apparatus (for both large & small boxes)
- ii) Tri-axial Shear Apparatus
- iii) Consolidation Apparatus
- iv) Uni - axial testing Apparatus
- v) Constant head permeability test apparatus
- vi) Variable head permeability test apparatus
- vii) Laboratory CBR test apparatus
- viii) Field CBR test apparatus
- ix) Fully Automatic consolidation Apparatus
- x) Fully automatic Tri-axial shear apparatus
- xi) Fully automatic Direct shear apparatus

E.3 Field Investigation

- 1) Pambar basin Projects – Reconstruction of Pattissery dam and canal system under Chengalar scheme – Site inspected and soil samples collected.
- 2) Field Investigation on D/S of the Bavikkara Regulator across Payaswini River in Kasaragode District.
- 3) KRP - LBC - Panjaraveedu branch canal – Conducting Trial Boring.

E.4 Conducting Pile Integrity Test Using Pile Echo Tester

- 1) NABARD - RIDF XX Construction of Regulator across Bharathapuzha at Koottakkadavu in Anakkara Panchayath, Palakkad District–Piles are not ready for testing.

E.5 Fundamental Studies

One fundamental study, “Conducting a study on co-relation between grain size distribution/specific gravity, OMC and CBR value” has been proposed and data for the study were collected. Analysis is to be conducted. Due to the shortage of technical staff, studies could not be continued.

E.6 Laboratory Investigation

The list of works carried out in the lab during the current year is given in Appendix-IV.

E.7 Ongoing Works

1. Engineering Structure Studies for setting up of an integrated Port Cum Ship Building Centre at Azhikkal Port in Kannur District – Testing of Sub soil samples.
2. Testing of soil sample for determining the properties of soil sample – M-tech. thesis of Sri. Muraleedharan M. A.

F. INSTRUMENTATION DIVISION

F.1 Introduction

Instrumentation Division acts as the mobile unit of Soil Mechanics Division and conducts various field tests. Site investigation is essential for judging soil suitability for proposed engineering work and preparing adequate design. It also helps for selecting suitable and economic construction materials as well as methods. Site exploration reveals reliable information about soil and ground water which will help the Engineer for an intelligent planning.

Soil samples are taken from sites on request and are transferred to Soil Mechanics and Foundation Division for testing. The following field tests are conducted by this division.

1. Plate Load Test for finding out the bearing capacity of soil.
2. Pile Load Test for determining the bearing capacity of pile.
3. Standard Penetration Test.
4. Dynamic Cone Penetration Test.
5. Collection of disturbed and undisturbed soil samples by hand auger and machine boring.

F.2 Activities of the division during the current year

This Division took part in the following work

F.2.1 Construction of Mini Dam with bridge cum regulator across Meenachil River at Arunapuram in Pala municipality

The above investigation work has been taken as per the instructions of the Chief Engineer, IDR B, Thiruvananthapuram. The Proposed check dam is located near Pastoral Orientation Centre. Here, bank height is more than 6m from river bed for both banks and retaining walls have been constructed to protect both banks. The Investigation work was carried out from 05/05/2016 to 14/05/2016.

F.2.2 Construction of Mulayam Lift Irrigation Scheme in Nadathara Panchayath.

The above investigation work has been taken as per the request of Executive Engineer, Minor Irrigation Division, Thrissur as per Lr.No.D2(D1)-455/11-12 dated:20/10/2016. The site available for the construction of pump house is very close to river. The Investigation work was carried out from 27/10/2016 to 29/10/2016.

F.2.3 Soil investigation of Pattissery Dam Saddle Portion

The boring plant was set up along the alignment suggested by Director, IDR B near the temple and the work was carried out from 8/02/2017 to 14/02/2017.

F.2.4 DRIP–Rehabilitation and improvement of basic facilities of Chimmoni irrigation project

The above investigation work has been taken as per the request of Executive Engineer, Irrigation Division, Thrissur as per Lr. No. D2553/09 dated:11/01/2017. The proposed site is at Chimmoni dam premises and the proposal is for the construction of Flat type quarters building. The investigation work was carried out from 30/1/2017 to 3/2/2017.

F.2.5 Construction of Regulator across Bharathapuzha at Chenganamkunnu, Ongallur panchayath in Palakkad District.

The Assistant Executive Engineer, Minor Irrigation Sub-division, Shoranur has requested to test the sand samples being used at Construction of Regulator across Bharathapuzha at Chenganamkunnu. Since the construction is being done across Bharathapuzha, the sand for construction is taken from the river bed itself. The site was inspected on 3/3/2017 and four numbers of sand samples were collected from the site.

F.3 Infrastructure

The important equipments available in the Division are

- Equipments for hand augering.
- Diesel boring plant

F.4 Procurement of New Machinery

1. Purchased a field vane shear test apparatus.



Shifting of Boring plant



Setting of boring plant



Boring work in river

G. PUBLICATIONS DIVISION

G.1 Introduction

Publications Division was acting as the information bureau of the Kerala Engineering Research institute. This division provides necessary technical information to all other divisions through its technical library containing around 10,000 books and a number of latest periodicals. An Engineering Museum consisting of the models of various completed irrigation projects, important bridges etc., is operated by this division and these replicas are quite useful and informative references for the technical persons and students. The three dimensional model of Kerala, known as the relief map of Kerala is a centre of attraction for people from any sector of life. This model is built to a scale of 1/16,000 horizontal and 1/1000 vertical and is absolutely of a unique configuration and is also operated by this division. This division conducts seminars and training programmes for the benefit of staff of the Institute. Also the division conducts

Trainings and Refresher courses for the staff of the Irrigation department. Now this Division was deployed with effect from 31/01/2017 and the activities are now being taken up under Instrumentation Division.

G.2 Activities of the Division

During the financial year 2016-17 the main areas of work attended by this division are:

- ❖ Maintenance and development of Library.
- ❖ Editing and publishing of Annual Report 2016-17.
- ❖ Conducting Seminars for the benefit of the technical hands and staff in the institute.
- ❖ Conducting Refresher courses for the Engineers and technical staff of the department.
- ❖ Operating the Engineering Museum and Relief Map of Kerala.
- ❖ Routine works of Publications Division.

G.3 Library Service

This division has an excellent technical library attached to it. Latest publications on topics of interest to research workers are being regularly added. The library is being used by many technical persons in different Government departments and also by a number of students from different Engineering Colleges and Polytechnics. Books are issued to officers attached to KERI using Library software. The card system is also being maintained. However facilities are extended to Engineers working in various departments and Institutions for referring the books.

The books are arranged in different shelves according to the subjects



G.3.1 Library Books

26 books were purchased to the library during this financial year.

G.3.2 Periodicals

A total of 9 numbers of Indian periodicals were subscribed by this division. The following journals were purchased by subscription during the year.

G.3.2.1 Indian Periodicals

1. Indian Concrete Journal
2. Electronics for You
3. The Bridge & Structural Engineer
4. Indian Journal of Power & River Valley Development
5. Civil Engineering and Construction Review
6. Inside Outside
7. Master builder
8. Down to earth
9. Indian Geo Technical Journal

G.4 Publication of Annual reports

Annual Reports for 2015-16 was published and copies were sent to important institutions and personnel.

G.5 Engineering Museum

This division is attending the operation of Engineering Museum attached to the Kerala Engineering Research Institute. The working model of major completed Irrigation Projects in Kerala is exhibited in this museum. It has also got a collection of the models of important bridges.

G.6 The Relief Model of Kerala, which is marked with all the salient features of Kerala has always been the centre of attraction of visitors who come to Peechi.



The Relief Model of Kerala

Constructed to a horizontal scale of 1/16000 and vertical scale of 1/1000, this model clearly shows rivers, roads, railways, location of Irrigation and power schemes, important places and district boundaries etc., in the state. In short, the model gives an idea of the topographical features of Kerala.

G.6.1 The Water a Divine Gift model gives a clear idea about the functioning of multipurpose project and the manifold uses to which water can be cheaply and conveniently put to.

G.7 Seminar Programme

A total number of eight seminars were conducted during this year.

Sl. No.	Title of paper	Name of speaker	Date
1	Green concrete	Sufeera O.B., Assistant Director, CM Division, KERI, Peechi.	09/05/2016
2	Micro Irrigation and precise Farming	Sheeja A. Andezhathu, Deputy Director, Instrumentation Division, KERI, Peechi.	08/07/2016
3	Electronic waste	Snisha T.B., Assistant Director, Coastal Engineering Division, KERI, Peechi.	29/07/2016
4	Geosynthetics and Standard tests	Geetha E.S., Assistant Director, Soil Mechanics Division, KERI, Peechi.	26/08/2016
5	Climate Change	Sudha M.S., Deputy Director, Hydraulics Division, KERI, Peechi.	28/09/2016
6	Development of mind for Orientation towards Research.	Dr. Santhosh Kumar P.T., Assistant Director, CM Division, KERI, Peechi.	16/11/2016
7	Wireless Sensor Networks	Dr. S. Swapnakumar Prof. and Head Department of Electronics & Communication Engineering, Vidya College of Engineering, Thrissur.	01/12/2016
8	Finite Element Analysis of Shored MSE Wall	Sri. Aswin Subhan, M Tech., Albertain Institute of Science & Technology, Kamady.	22/02/2017

G.8 Training and Refresher courses for Engineers and technical staff of Department

G.8.1 Training on “Preparation of Quality Manual for NABL accreditation”

The training was conducted at KERI on 14th October 2016 for the technical staff of K.E.R.I. 19 Delegates participated in the training.

G.8.2 Refresher course on “Laboratory works in Construction Materials and Soil Mechanics Labs”

The Refresher course on “Laboratory works in Construction materials and soil mechanics Labs” was conducted from 7th December, 2016 to 9th December, 2016 for Quality Control Division Thrissur of Irrigation department. 16 delegates participated in the programme. The classes were taken by Dr. Santhosh Kumar P.T., Assistant Director, CM Division, KERI, Peechi.



G.8.3. Refresher course on “Laboratory works in Construction materials and soil mechanics Labs”

The Refresher course was conducted on 18th and 20th January, 2016 for the Quality Control Division, Kottarakkara of Irrigation Department. 19 persons participated in the programme. The classes were taken by Geeta E.S., Deputy Director, Soil Mechanics Division, KERI, Peechi.



H. COASTAL ENGINEERING FIELD STUDIES, THRISSUR

H.1 Introduction

The Coastal Engineering Field Studies was formed in 1973 and is engaged in the collection of data and field studies on Coastal Erosion along the Kerala Coast. The coast of Kerala extending 576Km in the south west coast of India, is Characterized by a narrow longitudinal barrier strip of low-lying land, sandwiched between the Arabian Sea and a continuous chain of lagoons and back waters with connection to sea at several points. This strip is formed of alluvial deposits. In considerable stretches, the space between the sea and the back water

is very narrow and even less than a few hundred meters at many places. Any break in this narrow strip would expose the back water to the fury of the waves and could endanger the entire disappearance of the barrier beaches.

The coastal zone has the maximum concentration of population and is even many times the State average at several places. Many of the foreign exchange earning industries, residential localities, a number of district headquarters, good number of ports, fishing harbours and extensively cultivated land also exist along this narrow coastal zone.

The coastline of Kerala is subjected to severe erosion in a major portion of its length during the monsoons, when the sea becomes rough due to consistent attack of waves. The coastline is sometimes subject to tidal overflow also, when adjoining low lying lands get submerged. Erosion is very severe in the coastal areas during the south west monsoon period. During the worst monsoon period, the highest waves average 2.3metres and wave periods range from 9 to 12sec. and they come mostly from west. The normal tide range varies from 0.9metre in the south to 1.8m in the north. Storm tides occur all along the coast during the monsoon season. During the monsoon, the high waves coupled with storm surges, cause overflow and flooding of the low lying backshore lands all along the coast, resulting in considerable loss of property,

destruction of private and Government buildings, communications, dislocation of life of lakhs of population and disruption of other activities affecting economy. The influx of saline waters through mouths of rivers also affect agriculture and industry.

New CP stones have been planted throughout the Kerala coast except about 25km length of north extreme end at Manjeswaram. The GPS Co-ordinates of all CP stones have been recorded.

All aspects of the coastal erosion problems of the State, the necessity for immediate protection of vulnerable stretches, efforts made in collection of coastal data for long periods in conducting studies and in getting expert advice from all over the world and achievements made so far in tacking the erosion problem.

Many experts who visited this State, to study the behavior of the coast and also for periodical evaluation of the performance of completed sea walls, were all of the same opinion that the sea wall damage, mostly due to improper maintenance is as important as the construction of sea wall.

For proper construction and to understand the performance of the sea wall during and after construction, proper monitoring is necessary. This requires consideration of the field staff with the staff engaged in coastal erosion studies. Whenever a new sea wall is to be constructed, the research staff must be informed of the different stages of construction, starting from alignment of the sea wall forming filter, core, armour layers, etc., so that the performance of it during construction and after construction can be watched.

The field staff also must keep a date-war record of construction details starting from alignment, excavation, putting filter, forming core, armour layer, etc., as per lines and level. The distance and levels of stones in front of sea wall also must be watched regularly with the progress of construction of sea wall. All chainages of sea wall must be made with reference to the Km/C.P stone available at site

The concerned Assistant Engineers must give all relevant details to the concerned Assistant Directors in charge of Coastal Erosion Studies from time to time, as per the above guideline and also keep a copy of the same for reference.

H.2 General Arrangements and Field Studies

For the detailed study of the characteristics and behavior of the beach, the 576Km of the Kerala coast is divided into three regions viz., Southern region, Central region and Northern region. Each of these regions is under the control of Deputy Directors and further sub divided into the control of Assistant Directors. The three regions come under the Coastal Engineering Field Studies, headed by Joint Director who works under the guidance of Director, Fundamental and Applied Research, Kerala Engineering Research Institute, Peechi.

The extent of natural formation of beach, the position of protective dunes, the details of lagoons, inlets i.e., azhis are observed. Assessment of variation in tides and winds, movements of waves, littoral drift etc., are made. Also the general study of the important structures in the coast, natural bed slope and depth of water as far as possible up to the depth of closure of sea are also carried out, (which are to be examined in detail before any protection work is taken up). Thus the programme of study can be summarized as, Investigation of present conditions of sea coast by means of surveys and observations. Investigation of past history of coast from the available maps and records.

The specific factors for which specific data are being collected and obtained are as follows:

1. Shore History
2. Shoreline and shore depth changes
3. Accretion and erosion
4. Type of protection works installed and their effectiveness.
5. The direction, amount and character of littoral drift that produced the problem conditions.
6. Material characteristics composing the littoral zone.

7. Forces pertinent to the littoral zones
 - a) Waves
 - b) Currents
 - c) Tides
8. Effects of mud banks
9. Effects of inlets

H.2.1 Sub Items of Study

1. Fixing and maintaining Control Point stones, K.M.stones and Alignment stones.
 - a) Connecting levels of Control points.
 - b) Maintenance of existing control points, K.M.stones and Alignment stones.
 - c) Planting new and replanting missing CP Stones, KM stones, Alignment stones and Bench mark stones
2. Study of shoreline and shore depth changes
 - a) Taking cross section profiles
3. Physical Surveys
 - a) Topographic surveys
 - b) Periodical measurements of shorelines
 - c) Photograph
4. Study of littoral drift
5. Study of beach samples
6. Studies on wind, wave and tides
7. Studies on coastal protection works
8. Mud banks studies
9. Details of specific studies.
 - a) Studies on sea walls
10. Other Studies
 - a) Simultaneous Observations and daily observations

H.3 Details of Works

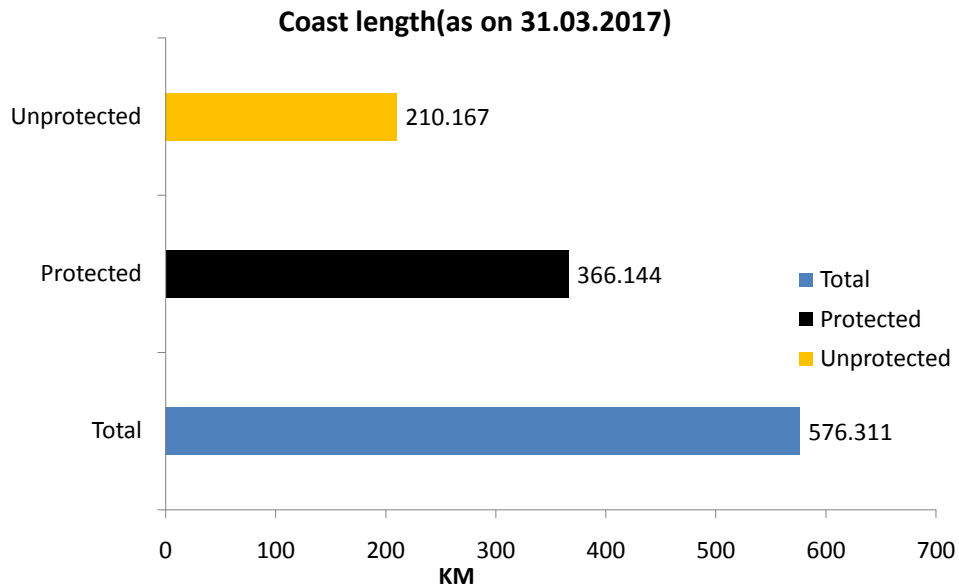
H.3.1 Planting of New Control Point Stones, Alignment Stones, Kilometer Stones and Benchmark Stones along the Sea Coast

Control Point Stones and Alignment Stones are the most important reference points for all the collection of data and for carrying out the protection works. In most area, levels are also established on those stones. The regions are referred by the Control Point stones. The references in certain reaches are made on BLS i.e., Base Line Stones. Shore line measurements, fixing of levels, topographic survey and similar important factors are based on these stones. Similarly, K.M. Stones are established to ear mark each region. BM stones are planted along the shore as permanent level marks. The levels on Control Point Stones are further checked on the basis of the B.M. stones. Many of the Control point stones and alignment stones are seen missing and damaged due to various reasons. Tendering of balance work of planting new CP stones, alignment stones, KM stones and BM stones along the sea coast under the jurisdiction of Thalassery for length of 25km was arranged, nobody turned up. Still pending.

H.3.2 Investigation Works

Field studies and collection of data on coastal erosion have been conducted on all section sunder this Division. All Kerala level, Coastal status is updated and Presentation was done at the Ministry Level. A copy of the same was sent to all the Divisions to construct the protection works at priority basis.

CURRENT STATUS OF COASTLINE-KERALA



Protection works at the priority basis

H.4 Programme of Study

In coastal environment, waves, tides, currents and winds are the important parameters which need to be considered for any development. It is very much essential to understand the physics of these process. Coastal erosion is the wearing away of land by the action of waves, current and wind. Coastal erosion is accompanied with landward recession of the sea shore and loss of land area. It is a common problem faced in almost all coastal areas. Only the magnitude and nature of erosion changes from place to place. Along the most part of Kerala coast, the erosion observed is seasonal in nature, that is, beach gets eroded during monsoon and regains its original profile during fair weather season. However, at some places erosion is of permanent nature.

H.4.1 Simultaneous Wave Observations

Simultaneous wave observations are being conducted at 18 specified location along Kerala Coast on all new moon days to understand characteristics of wind, wave and tide details such as width of back shore, fore shore, slope of fore shore, composition of

beach materials, characteristics of littoral drifts, shore history and they are recorded on standardized format.

H.4.1.1 Study of Littoral drift

Littoral transport is the movement of sediments in the near shore zone by waves and currents. This transport of suspended and bed load particles are both in parallel to the sea shore and perpendicular to sea shore. This transport of suspended materials is called littoral drift. It has been ascertained from the past studies that the dominant direction of littoral drift in Kerala coast is from north to south. However the directions, an annual quantity of net and gross quantity are important in developing shore protection arrangements. Now only the direction of drift is being studied at selected points along the shore.

H.4.1.2 Study of Wind, Wave and Tides.

Winds are the natural generators of wave and their study is necessary. An understanding of the nature of the tidal phenomenon is necessary for the study of coastal behaviors. The top level of the coastal protection structures depend on the tidal level and their data must be collected. Wave causes sand to move along the coast as well as on to or off a beach. Due to refraction, wave energy is concentrated in certain reaches of the coast where erosion became naturally severe. Hence the design of coastal protection structures primarily depends on wave characteristics and since these studies are essential (Predominant direction of waves is from west or North West).

H.4.1.3 Study of Mud banks

Mud banks, a phenomenon peculiar to the coast of Kerala are those in shore region where wave energy is dissipated completely as a result of the colloidal mud suspension mud bank protect the coast immediately near it, but causes erosion in the down-drift side due to diffraction of waves.

Many rivers in Kerala exhibit a continuous migrating tendency. Such migration influences the beach characteristics in the adjacent areas considerably.

H.4.2 Periodical Measurement of Shore line Changes:

Periodical surveys are taken to determine the shore line changes of the coast. The offset measurement of the shore line with respect to Control point and Alignment stones are taken every month and recorded. It provides very important data to understand the shore line fluctuation of the coast.

H.4.3 Collection and Study of Beach Samples

Pre-monsoon (May) and post-monsoon beach samples are collected from specified places for testing grain size distribution and specific gravity since the erosion and accretion of coast depends up on the nature of beach material to a certain extent. Also for natural nourishment materials can be supplemented to the beach and thereby the erosion can be reduced. Beach samples are important variables determining the beach characteristics. Study of beach materials, characteristics and sources is essential for the evolution of a long term shore protection plan.

H.4.4 Report on Coastal Damages and Taking Photographs

The details of damages at various places in the coastal beaches have been collected from time to time and photographs are taken to understand the details of erosion, coastal damages occurred during monsoon and drastic changes in the shore line. The details of damages caused during the year 2015 are listed in statement-3.

H.4.5 Topographic Survey along the Coast of Kerala

Topographic surveys are conducted to study the topographic changes of the beach.

H.4.6 Taking Cross Section Profile of the Beach

Cross section profiles taken using leveling instrument and leveling staff (Taken up to wading depth of waters)

H.4.7 Study of River outlets and Coastal inlets

Many rivers in Kerala exhibit a continuous migrating tendency. Such migration influences the beach characteristics in the adjacent areas considerably and hence to be studied in detail. Among these, periodical measurements of shoreline changes provide very important data to shoreline fluctuation of the coast.

H.4.8 Dates and Places of Observations

In order to have more detailed idea of the behavior of factors affecting the shore line changes, three consecutive points are taken for reference. At a particular study reach five readings are taken in all three points at definite timing. Nearly 20 to 25 Km apart straight reaches without much external disturbances are selected for taking these simultaneous observations. The places of observations with timing and CP Nos. are listed below. The dates in the year 2016 are as follows:

H.4.9 Alignment Fixation of Sea walls

The Joint Director inspected the sites for fixing alignment of sea wall (construction and reformation) with the concerned Irrigation officials, Deputy Director and Assistant Director of the Coastal Sub Division & Sections concerned, and approved the alignments of sea walls along Kerala Coast, considering the last 5year shore line measurements and the alignment of the sea.

Alignment approval has been given to the following works by the Joint Director, Coastal Engineering Field studies, Thrissur during the year 2015-16.

Sl. No.	Name of Sub Division	Alignment approved during 2016-17	Essentiality certificate issued during 2016-17
1	CE Sub Division, Kozhikode	1 No	1 No
2	CE Sub Division, Kollam	Nil	Nil
3	CE Sub Division, Ernakulam	Nil	Nil

H.5 Performance of the Division in 2016-17

Within the limitations of availability of funds, availability of field staff and modern instrument, this division has taken up all the possible studies in the year 2016-17. The performance can be summarized as follows.

Types of works

1.	Topographic survey conducted for Determining beach profiles	Nil
2.	Periodical measurement of shoreline changes	4341.897 Km
3.	Simultaneous observations	288 Set
4.	Taking photograph	72Nos.
5.	Soil sample collected	53 Set.
6.	Cross section profiles	Nil
7.	Levels connected	Nil
8.	C.P Stones planted	Nil
9.	Alignment stones planted	Nil
10.	Kilometer stones planted	Nil
11.	Bench mark stones plant	Nil
12.	Alignment fixed by Joint Director	1No.
13.	Details of damages at various places in the Coastal beaches collected (separately attached - Statement No.3)	72 Nos.
14.	Mud bank study	Nil

H.6 Sub Division-wise Coastal studies performance are as follows:**1. Topographic survey conducted**

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

2. Periodical measurement of shoreline changes

Kollam sub Division	:	1500 Km
Ernakulam Sub Division	:	1125.95 Km
Kozhikode Sub Division	:	1716.00 Km

3. Simultaneous observations

Kollam sub Division	:	60 Set.
Ernakulam Sub Division	:	36 Set
Kozhikode Sub Division	:	84 Nos

4. Taking photograph

Kollam Sub Division	:	45Nos
Ernakulam Sub Division	:	22 Nos
Kozhikode Sub Division	:	52 Nos.

5. Soil sample collected

Kollam sub Division	:	10 Set
Ernakulam Sub Division	:	12 Set
Kozhikode Sub Division	:	14 Set

6. Cross section profiles

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

7. Levels connected

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

8. C.P Stones planted

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

9. Alignment stones planted

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

10. Kilometer stones planted

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

11. Bench mark stones planted

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

12. Guard stones planted

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

**13. Details of damages at various places in the Coastal beaches collected
(Separately attached statement No.3)**

Kollam sub Division	:	Nos.
Ernakulam Sub Division	:	Nos.
Kozhikode Sub Division	:	Nos.

14. Study of Mud bank

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

The coastal data of Periodical measurements which backs to 1990 has been digitized and the digitization of available data of sled survey is in progress.

H.7 Bottleneck Facing

Coastal Engineering Field Studies is the one and only institution entrusted with the collection of coastal field data and field studies connected with the erosion of the entire sea coast of Kerala, the functions assigned to which are vital & essential. But at present CEFS is provided with bare minimum facilities. The office building of CEFS Thrissur is in a pathetic condition and it is a Herculean task to protect the valuable records of collected data. Similarly it is very cumbersome to consolidate and process the valuable data collected for the last so many years manually and are being deteriorated. However the staff of Coastal Engineering Field Studies took great effort to digitize available maximum data for the past 25 years.

The Chairman, Coastal Protection and Development Advisory Committee (CPDAC) had advised the Chief Secretaries of all Coastal States to create a separate department for dealing with the Coastal Engineering works of the respective states vide Lr.No.4(5)/2000 CED dated:09/06/2000 to organize a coordinated program of collection, compilation, evaluation and publication of coastal data. Hence this wing is to be made permanent.

The staff strength of the wing is insufficient even for the routine performance. The CEFS Division is not having the posts of PA/TA., DA. The only two posts of clerks were declared as supernumerary. Only an Assistant Director is available in Parappanangadi section for the last ten years for meeting all the activities.

Coastal Engineering Section, Thalassery coming under the control of Deputy Director, Kozhikode Sub division extends from Mahe to Manjeswaram with a length of 148km. At present only 90km is under study reach. No study is being conducted in the remaining 58km (excluding Naval Academy and Bakel fort). Assistant Director of each section is collecting field data and doing survey works for an average length of about 60km with the assistance of 2 Draftsman/Overseer.

As far as Kerala Coast is concerned, the sea is turbulent, especially during monsoon and coastal erosion is a common phenomena along the sea coast for which continuous field study in all aspects is essential. But it is regretted to state that the budget provision, which was around 100lakh during the nineteen nineties, has got reduced considerably in the recent years to 5lakh bringing the survey works to almost stand still. At present the wing is collecting data on shoreline measurements, simultaneous observation, preparation of coastal damage reports with photographs and collecting soil samples only. Training programs on Coastal Engineering and allied subjects to update and train the technical personnel of the department regarding the latest development in this field is essential. No training has been conducted under this wing due to lack of funds. The study wing now follows old conventional method of observations like visual observations, tape measurements etc. High derivative modern instruments are now available in this field.

The driver post for the Jeep under CEFS Division and Kollam remains vacant for a long time and it adversely affects the momentum of work schedule. The availability of vehicles is helpful in carrying out our studies as coastal areas are not easily accessible everywhere and private vehicles are reluctant for a trip to these remote areas with pathetic road conditions.

H.8 Suggestions/Recommendations

Sufficient fund has to be made available in time for conducting the entire study of coastal erosion. The coastal length coming under the jurisdiction of Thalassery section is 148km, and for studying the entire /reach an additional section is to be formed.

The location of new International Port at Vizhinjam is between CP45 and 55. The construction authority has formed artificial shore and road by using materials drilled from the sea and breakwater construction is in progress. This area needs some specific studies for shoreline characteristics before and after the construction of Vizhinjam Port. Here due to terrain of land CP Stones have not been planted.

Some of the CP stones have been swallowed by the sea waves and some got destroyed by the weathering actions. As the new CP stones have not been planted for the continuous stretch, that profile could not be adopted for aligning sea walls etc. Hence CP stone planting and its timely maintenance is essential.

For getting the sufficient staff strength and for their maximum efficiency this wing is to be made permanent, considering the importance of this Division. Sufficient fund should be allocated for the training of technical staff and for procuring the modern scientific equipments for the collection of coastal data.

5. FINANCE

In the budget for the financial year 2016-17 an outlay of Rs.85 lakh had been allotted under the Head of Account '4701-80-800-99-Development of KERI Stage II'. The proposal for the amount was grouped under three heads viz., Routine activities, modernization and revamping. The details of sanctioned amount and expenditure are given below. From the routine works carried out in the laboratories an amount of Rs.13,71,520/- has been collected as test charges and the amount was remitted in the treasury.

Details of sanctioned Amount and Expenditure

Sl. No.	Divisions	A.S. Amount
I	Joint Director, C.M.&F.E., KERI, Peechi.	
1	Construction Materials Division	14.15lakh
2	Soil Mechanics and Foundations Division	10 lakh
3	Instrumentation Division	6 lakh
4	Publications Division	4 lakh
	Total amount received	34,15,000/-
	Expenditure	32,21,594/-
II	Joint Director, Hydraulic Research, KERI, Peechi.	
1	Coastal Engineering Division	9.20 lakh
2	Hydraulics Division	13.30 lakh
3	Sedimentation Division	17.5 lakh
	Total amount received	40,00,000/-
	Expenditure	33,75000/-

6. SUMMARY

In the annual report for the current financial year a general introduction about the institute, organization set up, division wise functioning of the institute, implementation of modernization scheme and details regarding budget allotment and expenditure have been explained in detail.

The bottlenecks or hindrance in the development of the institute as a full fledged research organization are

- ✚ Insufficient number of technical personnel.
- ✚ Lack of well qualified engineers.
- ✚ Lack of up-gradation of technical knowledge of engineers through training.
- ✚ Insufficient number of projects/under utilization of the facilities available at the institute.
- ✚ In the case of Field studies division, sufficient fund has to be made available in time for conducting the study of coastal erosion and high derivative modern equipments has to be made available.
- ✚ The building of CEFS, Thrissur which is in a dilapidated condition has to be modified.

All these require intervention from the part of the Government and it is hoped that the up gradation of the personnel of the institute will be taken up as a continuation of the modernization scheme.

Appendix – I**Vacancy Position as on 31/03/2017, KERI, Peechi**

Sl. No	Designation	Sanctioned Strength					No of Posts Vacant					Remarks
		O/o Director	CM&FE	Hydraulic Research	CEFS	Total	O/o Director	CM&FE	Hydraulic Research	CEFS	Total	
1	Director	1	-	-	-	1	-	-	-	-	-	
2	Joint Director	-	1	1	1	3	-	-	-	-	-	
3	Deputy Director	-	3	3	3	9	-	-	-	-	-	
4	Assistant Director	1	6	7	10	24	-	3	-	1	4	
5	Divisional Accountant	-	-	1	-	1	-	-	-	-	-	
6	Junior Superintendent	-	1	1	-	2	-	-	-	-	-	
7	Fair Copy Superintendent	-	-	1	-	1	-	-	-	-	-	
8	Selection Grade Typist/ UD Typist	-	2	1	1	4	-	-	-	-	-	
9	Research Assistant	1	8	7	9	25	-	6	2	-	8	
10	2 nd Grade Overseer	1	4	4	12	21	-	2	2	4	8	
11	3 rd Grade Overseer	-	3	2	-	5	-	3	2	-	5	
12	Scientific Assistant	-	1	1	-	2	-	1	1	-	2	
13	Tracer	-	-	1	-	1	-	-	-	-	-	
14	Blue Printer	-	-	1	-	1	-	-	-	-	-	
15	Driver	-	0	1	3	4	-	-	-	-	-	
16	Boat Driver	-	-	1	-	1	-	-	1	-	1	
17	Lab Attender	-	1	1	-	2	-	1	1	-	2	
18	Modeler	-	-	1	-	1	-	-	1	-	1	
19	Mason	-	-	1	-	1	-	-	1	-	1	
20	Worker Grade I/II	-	6	8	-	14	-	4	8	-	12	
21	Head Clerk	-	-	-	1	1	-	-	-	-	-	
22	UD Clerk	2	1	-	4	7	-	-	-	-	-	
23	Senior clerk	-	-	4	-	4	-	-	-	-	-	
24	LD Clerk	2	7	3	7	19	-	1	-	1	2	1 No. Deployed to MP
25	LD Typist	1	-	1	1	3	-	-	-	-	-	
26	Typist Clerk	-	3	1	-	4	-	1	-	-	1	
27	Office Attendant	2	6	3	13	24	-	2	1	5	8	
28	Part Time Sweeper	-	4	1	3	8	-	1	-	-	1	
29	Lab Assistant	-	2	-	-	2	-	2	-	-	2	
30	Information Assistant	-	1	-	-	1	-	1	-	-	1	
31	Assistant Surgeon	-	1	-	-	1	-	-	-	-	-	Deployed with effect from 31/01/2017
32	Pharmacist	-	1	-	-	1	-	-	-	-	-	
33	JPHN	-	1	-	-	1	-	-	-	-	-	
34	Hospital Attendant Gr.II	-	1	-	-	1	-	-	-	-	-	
35	Nursing Assistant	-	1	-	-	1	-	-	-	-	-	

Appendix – II

An abstract of the Weather data collected from Automatic Weather Station for the period from April 2016 to March 2017 is given below

**Abstract of the weather data (AWS) from April 2016 to
March 2017**

STATION: K.E.R.I., PEECHI.

Latitude- 10° 31' 30" N Longitude- 76° 21' 59" E MSL- +96.03 M.

Sl.No	Weather Elements	Range of the weather data
1.	Atmospheric pressure	Maximum Atmospheric Pressure observed was 1004.2 mill bars on September -2016 and Minimum Atmospheric Pressure was 991.6 mill bars on May-2016
2.	Temperature	The maximum temperature was 39.2°C on March-2017 and the minimum temperature was 19.10°C on January-2017
3.	Relative Humidity	Maximum relative humidity recorded was 100% in all the months and minimum relative humidity was 15.8% on March-2017
4.	Precipitation	Annual rainfall was 1164.80 mm and the maximum rainfall was 89.8 mm on June, 2016 and minimum rainfall 0.10mm on July & September, 2016.
5.	Wind-Direction	The main wind directions observed were from South East and North East directions.
6.	Wind Speed	Maximum daily mean wind speed was 4.2 km/hr on February, 2017 and minimum daily mean wind speed was 0.40 km/hr. from July to December, 2016.

Appendix – III**List of tests conducted in the CM laboratory****D.3 Routine Tests Conducted (April, 2016 to March, 2017)**

1. Tension test for steel rods supplied by the Asst. Exe. Engineer PWD Special buildings section Thrissur
2. Compressive Test strength of concrete paver blocks supplied by M/s KFRI Peechi
3. Testing of aggregates and cement supplied by Tekton Builders and Contractors RMC Yard Cum Plant Thrissur
4. Testing of concrete cubes supplied by the Assistant Engineer, PWD, Building Section, Chalakudy.
5. Testing of Steel and Aggregates supplied by the Assistant Engineer, PWD, Building Sn Kodungallur
6. Testing of concrete cubes supplied by Davis Anto Pallippat (H) Chalakudy.
7. Testing of concrete cubes supplied by the Assistant Exe. Engineer IQC Thrissur.
8. Concrete mix design by M/s HLL Life care LTD Kodungallur.
9. Testing of concrete cubes by KFRI Peechi
10. Testing of rock sample Supplied By M/s Sediment soil Investigation Cochin
11. Testing of steel rods by Senior Section Engineer southern railway Ernakulam.
12. Concrete mix design by Asst. Engineer Sn. No-ii Harbour Engg.Sub.Dn., Chettuva.
13. Compressive Test strength of concrete paver blocks supplied by M/s KFRI Peechi.
14. Testing of Steel and Aggregates supplied by the Assistant Engineer, PWD, Building Sn., Chalakudy
15. Concrete mix design by the Asst .Exe. Engineer Irrigation Sub.Dn., Piravam.
16. Testing of concrete cubes supplied by the Assistant Engineer PWD Building Sn Thrissur

17. Testing of cement,Aggregates & steel rods supplied by the Asst.Exe.Engineer MI. Sub. Dn.,Shoranur.
18. Bend and Rebend Test for steel rods supplied by senior Sn.Engineer(works) Consultant Ernakulam
19. Testing of River sand supplied by Sri Mohan Das V.A (H) no.31/85 Methala, Kodungallur.
20. Testing of concrete cubes supplied by the Assistant Engineer,PWD, Building Section, Kodungallur
21. Testing of concrete cubes supplied by the Assistant Engineer,PWD, Building Section, Chalakudy
22. Testing of concrete cubes supplied by the Assistant Engineer,PWD, Building Section, Chalakudy
23. Testing of steel rods supplied by M/s NCC Limited Thrissur. (Tension Test & Bend and Rebend Test)
24. Testing of concrete cubes supplied by M/s Fins Engineers & Contractors Thrissur
25. Testing of concrete cubes supplied by the Assistant Engineer IQC Section Thrissur
26. Testing of Aggregates by M/s Ceecon Ready mixed-concrete Pvt. Ltd, Pudukad
27. Testing of concrete cubes supplied by the Assistant Engineer IQC Section Thrissur
28. Testing of cement and Aggregates supplied By M/s NCC Ltd Thrissur
29. Testing of concrete cubes supplied by M/s Fins Engineers & Contractors Thrissur
30. Testing of cement, Steel and Aggregates supplied By Asst. Engineer Irrigation Quality Control Section Palakkad.
31. Breaking load test of chain hoist& tension test for wire rope supplied by the Mechancial sub division, Thenmala
32. Concrete Mix Design , Tension test for steel rods compression test of concrete cubes supplied by the Project Manger, CAPE, Wadakancherry

33. Testing of rock samples (compression test, Water absorption & Specific gravity) supplied by the Sri Jayakrishnamenon, Director, EDC(p) LTD Cochin
34. Testing of concrete cubes supplied by M/S Lulu Project Thrissur.
35. Testing of concrete cubes supplied by the Assistant Engineer, PWD, Building Section, Chalakudy.
36. Testing of concrete cubes supplied by the Assistant Exe. Engineer, Harbour Engineering Sub Division Chettuva
37. Tension test of steel rods supplied by the Assistant Engineer, PWD, Building Section, Chalakudy
38. Testing of solid blocks supplied by Sri. JohnyValluran, Grace mart city Buildings, Pattikkad.
39. Compressive strength of paver blocks supplied by the registrar, KFRI, Peechi
40. Tension test of steel rods supplied by Sri. Siju Jose, Parakkal (H) Kanjoor.)
41. Concrete Mix Design by the Assistant Engineer, Harbour Engineering sub Dn., Chettuva
42. Testing of concrete cubes supplied by M/S NCC LTD, Thrissur
43. Concrete Mix Design by the Assistant Exe. Engineer, KWA, Guruvayoor.
44. Compressive strength of paver blocks supplied by Sri. Chandran, Pattikkad
45. Testing of concrete cubes supplied by M/S NCC/Lulu , Thrissur
46. Testing of Cement, Aggregates & Wire mesh supplied by Assistant Engineer, CP Sn., Chimmony Dam.
47. Testing of concrete cubes supplied by M/S NCC/Lulu, Thrissur
48. Testing of wire rope by Assistant Engineer Sn II, Mechanical Sub Dn., Perumbavoor
49. Testing of concrete cubes& solid blocks supplied by Assistant Engineer, PWD Building Sn., Chalakudy
50. Testing of rock samples supplied by M/S EDC (P) Ltd Pullappady, Cochin.
51. Tension test of steel rods supplied by the Assistant Engineer, PWD, Building Section, Chalakudy.
52. Testing of solid blocks supplied by Sri. Johny Valluran, Grace mart city Buildings, Pattikkad

53. Testing of concrete cubes supplied by Assistant Engineer, Irrigation Quality control section, Thrissur.
54. Testing of aggregates supplied by Mechanical Engineer, Southern rock & Aggregates mining company
55. Testing of concrete cubes supplied by Assistant Engineer, PWD Building Sn, Chalakudy
56. Breaking load test for wire rope supplied by Assistant Engineer, Mechanical sub Dn., Perubavoor
57. Testing of concrete cubes supplied by Assistant Engineer, PWD Building Sn, Chalakudy
58. Testing of concrete cubes supplied by M/S RT Arch Kochi
59. Testing of cement, steel & aggregates supplied by Assistant Engineer, Irrigation Sn., Aluva.
60. Testing of concrete cubes supplied by Assistant Engineer, Irrigation Quality control section, Thrissur
61. Testing of concrete cubes supplied by Assistant Engineer, Irrigation Quality control section, Palakkad
62. Testing of cement, steel & aggregates supplied by Assistant Engineer, Irrigation Head works Sn., Peechi.
63. Testing of concrete cover blocks supplied by M/S NCC LTD Thrissur.
64. Testing of Concrete cubes supplied by Assistant engineer, HW Sn., Peechi.
65. Testing of M sand supplied by Assistant Engineer, Irrigation Quality control section, Thrissur
66. Testing of concrete cubes supplied by Assistant Engineer, PWD Building Sn, Chalakudy
67. Testing of Concrete cubes supplied by Assistant engineer, HW Sn., Peechi.
68. Testing of concrete cubes supplied by Assistant Engineer, Irrigation Quality control section, Thrissur.
69. Breaking load test of 20mm wire rope by Assistant Engineer, Sn No III Thanneermukkam Project, Alappuzha

70. Breaking load test of 12mm wire by Assistant Engineer, Dredger sub division, EKM
71. Tension test for M.S rods upto 25mm dia. by Assistant Engineer, H.W Sn., Thumburmuzhi.
72. Testing of rock samples by M/S Sediment soil Investigation, Palarivattom.
73. Tension test for MS rods upto 25mm dia by M/S Tekton, Thrissur.
74. Compressive strength of bricks & Concrete cubes Supplied by Assistant Engineer, Quality control Sn., Palakkad.
75. Testing of tiles by Assistant Engineer, CPWD, Thrissur.
76. Testing of rock samples by M/S EDC, Ernakulam.
77. Testing of concrete cubes supplied by Assistant Engineer, PWD Building Sn., Chalakudy
78. Breaking load test of wire rope supplied by Assistant Engineer, Sn. II., Mechanical sub division, Perumbavoor.
79. Testing of concrete cubes supplied by Assistant Engineer, quality control Sn Palakkad
80. Testing of concrete cubes supplied by Assistant Engineer, quality control Sn Palakkad
81. Concrete Mix Design supplied by Assistant Engineer, PWD Building sn, Wadakancherry
82. Testing of steel rods supplied by Assistant engineer, PWD Building sn, Thrissur
83. Testing of Aggregates supplied by Assistant engineer, PWD Building sn, Irinjalakuda
84. .Compressive strength of Brick samples supplied by The Project Manager, HLL ID Division, Thrissur
85. Sieve analysis of aggregates and Tension test of for steel rods supplied by Assistant engineer, PWD Building Sn, Irinjalakuda.
86. Compressive strength of solid blocks supplied by Assistant Engineer, PWD Building Sn., Chalakudy.

87. Testing of Laterite Samples supplied by Sri Peter. G. PWD Contractor, Star Nivas, Edappally.
88. Concrete Mix Design & Tension test for steel rods supplied by Assistant Engineer, PWD Bridges Sn, Thrissur.
89. Testing of cement, Welded mesh and 16mm square M.S bars supplied by Assistant Engineer Sn No:2 Chimoni Dam Project.
90. Compressive strength of solid blocks supplied by Assistant Engineer, PWD Building Sn.I, Thrissur.
91. Compressive strength of Concrete Cubes supplied by Assistant Engineer, PWD Building Sn., Kodungallur.
92. Concrete Mix Design & Tension test by Section Engineer, Southern Railway
93. Compressive strength of solid blocks by confix contractors pazhanji, Malappuram
94. Sieve analysis of aggregates supplied by assistant engineer T.C Section Pudukkad
95. Compressive strength of Concrete Cubes supplied by Assistant Engineer, PWD Building Sn., Chalakudy
96. Compressive strength test for core sample and bricks Cubes supplied by Assistant Engineer, CDP section No-2
97. Test for cement supplied by Nalin Agencies,Cement Stockest,Muringor.
98. Compressive strength test of bricks supplied by HLL products Kodungallur
99. Compressive strength test for concrete paver blocks supplied by M/s Podippara cement works, Peechi
100. Compressive strength test for concrete solid blocks supplied by M/S NCC Ltd Thrissur
101. Tension test for steel rods supplied by Assistant Engineer, CDP section No-2
102. Compressive strength test for concrete cubes by Assistant Engineer Quality control section Thrissur
103. Compressive strength test for mortar cubes supplied by Sri. Muralidharan MA, M.Tech student EASA college of engineering Coimbatore.
104. Testing of vitrified tiles supplied by Asst. Exe. Engineer, KSEB Kalamassery.

105. Concrete mix design by AM Sulaika Asst. Exe. Engineer IIP sub division No-3 Malayattor
106. compressive strength of concrete cubes supplied by Asst. Engineer Q.C Sn Thrissur for Nadathara Mulayam LIS
107. Compressive strength test for concrete cubes by the Asst. Exe. Engineer head works section Peechi.
108. Tension test for Steel rods supplied by the Asst. Engineer PWD Building Sn Wadakancherry
109. Compressive strength test for concrete cubes supplied by the Asst. Engineer PWD Road Sn Kodungallur
110. Compressive strength test for concrete cubes supplied by the Asst. Engineer PWD Building Sn Chalakudy
111. Concrete mix design for the Asst. Engineer PWD Building Sn No-1 Thrissur
112. Tension test for steel rods supplied by the Asst. Engineer head works section, Peechi
113. compressive strength of concrete cubes supplied by Asst. Engineer Q.C Sn Thrissur for RCB at Attappilly
114. Sieve analysis of Fine & Coarse aggregates supplied by Assistant Engineer, M.I Section Shornur.
115. Sieve analysis of Aggregates, Tension Test for steel rods & Compressive strength test for solid blocks Supplied by M/S HPCL, Kozhikode
116. Sieve analysis of Aggregates, Tension Test for steel rods supplied by M/S NCC Ltd, Thrissur.
117. Concrete Mix Design by Assistant Engineer, PWD Building Sn., Wadakancherry.
118. Compressive strength test for concrete cubes supplied by M/S HPCL, Kozhikode
119. compressive strength of concrete cubes supplied by Asst. Engineer Q.C. Sn Thrissur for RCB at Attappilly

120. Compressive strength test for concrete Solid Blocks supplied by the Bharath Cement Corporation
121. Concrete Mix Design by the Project Manager, Mahindra Holidays & Resorts India Ltd, Chavara, Kollam.
122. Testing of solid Blocks By M/s NCC Ltd Thrissur.
123. Concrete Mix Design by the Assistant Engineer, PWD Building Sn I, Thrissur.
124. Concrete Mix Design by the Assistant Exe. Engineer, Irrigation Sub Division, Piravam.
125. Testing of precast Chequered Tiles Supplied by senior section Engineer (Works) Ernakulam
126. Compressive strength test for concrete cubes supplied by M/S HPCL, Kozhikode
127. Concrete Mix Design by the Assistant Engineer, PWD Building Sn. I, Thrissur.
128. Concrete Mix Design by the Assistant Ex Engineer, Irrigation Sub Division, Piravam
129. Compressive strength test for concrete cubes supplied by the Asst. Engineer PWD building wing Chalakudy.
130. Compressive strength test for concrete cubes supplied M/s Salim Associates, Guruvayoor.
131. Testing of Cement, Steel & Aggregates Supplied by the Assistant Engineer, Sn No:I, Chimmony Dam Project, Echippara
132. Tensile strength of steel rods supplied by QC Sn Thrissur
133. Concrete Mix Design by the Senior section Engineer, Southern Railway, Thrissur.
134. Compressive strength test for concrete cubes supplied by the Asst. Engineer, Quality control Sn, Thrissur.
135. Compressive strength test for concrete cubes supplied by M/S HPCL, Kozhikode.

136. Compressive strength test for concrete cubes supplied by Mr. Jiby Paul for PWD Roads Sn, Kodungallur.
137. Compressive strength test for concrete cubes supplied by Assistant Engineer, PWD Road, Town Sn Thrissur.
138. Compressive strength test for concrete cubes supplied by Assistant Engineer, PWD Road Sn, Valappad.
139. Compressive strength test for concrete cubes supplied by Assistant Engineer, PWD Building section, Chalakudy.
140. Compressive strength test for concrete cubes supplied by Assistant Engineer, Quality control Section, Thrissur.
141. Tension test for Steel rods supplied by the Asst. Engineer Quality control sn., Thrissur.
142. Mix design by Assistant Engineer, M.I Section, Thrithala.
143. Tension test for Steel rods supplied by the Asst. Engineer, Chimmony Dam Project Section, Echippara.
144. Mix design by Southern Railway, Kollam.
145. Compressive strength test for concrete cubes supplied by Assistant Engineer, PWD Building section, Chalakudy.
146. Compressive strength test for concrete cubes supplied by Assistant Engineer, IQC, Palakkad.
147. Compressive strength test for concrete cubes supplied by PWD Road Sn, Cherp.
148. Compressive strength test for concrete cubes supplied by Assistant Ex Engineer, Harbour Engineering sub division, Chettuva, Kundaliyoor.
149. Compressive strength test for concrete cubes supplied by Assistant Engineer, Head works Sn, Peechi.
150. Mix design by the Project manager Club Mahinder, Ashtamudi Resort.
151. Flexural strength of tiles supplied by Vaisak P.V, Mechanical NCERC, Pampady.
152. Testing of solid blocks for NCC for Lulu, Thrissur.

153. Tension test for Steel rods supplied by the Phoenix Infrabuild, Mahindere Holiday & Resorts
154. Sieve analysis of coarse aggregates supplied by the Phoenix Infrabuild, Mahindere Holiday & Resorts
155. Mix design for Assistant Executive Engineer, MVIP sub Dn. No:8, Vazhakulam.
156. Compressive strength test for concrete cubes supplied by Assistant Engineer, IQC, Thrissur.
157. Compressive strength test for concrete cubes supplied by Assistant Engineer, IQC, Thrissur.
158. Tension test for Steel rods supplied by Assistant Engineer, Chimmony Dam Project Sn No :2, Echippara.
159. Testing of Tiles by Syamala,K.P, Sasta petrol pump, Puthur, Thrissur.
160. Testing of solid blocks by Adat grama Panchayath.
161. Testing of solid blocks & concrete cubes by The Assistant Engineer, PWD Building section, Irinjalakuda.
162. Compressive strength test for concrete cubes supplied by Assistant Engineer, IQC, Thrissur.
163. Compressive strength of paving blocks supplied by Fins engineers & Contractors
164. Compressive strength of paving blocks supplied by Hindusthan Petroleum Corporation, Kozhikode.
165. Compressive strength of Concrete cubes supplied by the Assistant Engineer, PWD Building section, Chalakudy.
166. Testing compressive strength of core taken from the Aqueduct at Kuttiyadi Irrigation Project.
167. Testing cement, Aggregate & Steel bar supplied by the Assistant Engineer, Walayar Dam section.
168. Compressive strength of Concrete supplied by Assistant Engineer, Head works Sn, Peechi.

169. Compressive strength of paving Tiles supplied by Assistant Engineer, Irrigation Sn., Aluva.
170. Compressive strength test for concrete cubes supplied by Assistant Engineer, Chimmony Dam Sn, Echippara.
171. Compressive strength, Water absorption & Abrassion test of paving Tiles supplied by Assistant Engineer, Irrigation Sn., Aluva.
172. Testing granular sub base and wet Mix Macadam of the coarse aggregates supplied by Assistant Engineer, PWD road Sn, Thrissur.
173. Water absorption Test of a water proofing compound (IZONIL) supplied by CEO, Pratheesh Menon P, Octagreen, Nanoproducts, Elamakkara (P.O), Kochi.
174. Compressive strength of Paver Blocks supplied by Assistant Engineer, LSGD Sn, Nadathara Grama Panchayath, Thrissur.
175. Compressive strength of concrete tiles & Paver Blocks supplied by Sri George Baby, managing Partner, (SCORIPPIO) Designer Tiles, Adoor.
176. Testing of coarse aggregates & Steel rods supplied by the Assistant Engineer, M.I Section, Thrithala.
177. Compressive strength of Concrete cubes supplied by the Assistant Engineer, PWD Building section , Chalakudy
178. Compressive strength of Inter locking Paving Tiles supplied by the Assistant Exe. Engineer, TC Sub Dn, KSEB, Madakathara.
179. Compressive strength of Concrete cubes supplied by Vipin Vijayan, Malabar college of Engineering, Desamangalam.
180. Compressive strength test for concrete cubes & Tension test for steel rods supplied by Assistant Engineer, IQC, Thrissur.
181. Tension test for Steel rods supplied by Assistant Engineer, PWD Building sn, Kunnamkulam.
182. Testing granular sub base and wet Mix Macadam of the coarse aggregates supplied by Assistant Engineer, PWD Road Sn, Thrissur
183. Sieve analysis of coarse aggregates supplied by Assistant Engineer, PWD Road Sn, Thrissur

184. Sieve analysis of sand samples supplied by Deputy Director, Instrumentation Division, KERI, Peechi. sand supplied RCB across Bharathapuzha at Chenganamkunnu, Ongallur Panchayath.
185. Compressive strength test for concrete cubes supplied by Assistant Engineer, PWD Road Section, Valappad.
186. Cores were taken & strength determined for the work of “Deck slab of Illikulam Railway thodu in Karipuzha”, Kayamkulam.
187. Compressive strength test for concrete cubes supplied by Assistant Engineer, Chimmoni Dam Project for constructing a RCB at Attappilly across Kurumali river.
188. Compressive strength test for concrete cubes supplied by Assistant Engineer, IQC, Thrissur for constructing a RCB at Attappilly across Kurumali river.
189. Tension test for Steel rods supplied by Senior Section Engineer (Works), Southern Railway, Thrissur.
190. Testing of cement supplied by Assistant Engineer, Chimmoni Dam Project, Echippara.(KCP Cement)
191. Testing of cement supplied by Assistant Engineer, Chimmoni Dam Project, Echippara. (Coromandal king)
192. Compressive strength test for concrete cubes supplied by Assistant Engineer, Chimmoni Dam Project, Echippara.
193. Testing of Aggregates supplied by Assistant Engineer, PWD Building Section, Kodungalur
194. Tension test for Steel rods supplied by Assistant Ex: Engineer, Engineering sub Division, Vellanikkara.
195. Compressive strength test for concrete cubes supplied by Assistant Engineer, T.C Sn, KSEB, Chalakudy.
196. Tension test for Steel rods supplied by Assistant Engineer, PWD, Building Section, Ayyanthole.
197. Compressive strength test for concrete cubes supplied by Mr: shanu S, NCC LTD
198. Compressive strength test for concrete cubes supplied by the Project Manager, Salim Associates, Guruvayoor

199. Compressive strength test for concrete cubes supplied M/s Ceecon, Ready Mix Pvt Ltd, Pudukkad.
200. Compressive strength test for concrete cubes supplied by Assistant Engineer, PWD Building Sn, Irinjalakuda.
201. Testing of Coarse Aggregates supplied by Assistant Engineer Road Sn Kodakara.
202. Compressive strength test for concrete cubes supplied by M/S Salim Associates and Builders Nandanam Heaven Pudukad.
203. Compressive strength test for concrete cubes supplied by Senior Section Engineer southern Railway Thrissur.
204. Concrete Mix Design by Assistant Exe. Engineer KYIP, Peruvannamoozhi.
205. Testing of Coarse Aggregates supplied by Asst. Engineer Head Works Sn Peechi.
206. Mix design By Assistant Engineer PWD Building Sn Thrissur.
207. Testing of Aggregates and M Sand supplied by Power Grid Corporation of India Kozhikode.
208. Testing of Cement by Assistant Engineer KPIP Sn No.4/3 Kanhirapuzha.
209. Testing of paver blocks supplied by Assistant Exe. Engineer, Engineering Sub Division Vellanikkara.
210. Compressive strength test for concrete cubes supplied by Assistant Engineer Chimmoni Dam Project Sn Echippara.

Appendix – IV

List of tests conducted in the SM Laboratory

E.6 Laboratory Investigation

Soil samples analysis for undisturbed and disturbed samples were tested for the following works:-

- E.6.1 Pambar Basin - Chengalar Scheme – Pattissery dam – Physical and Chemical Properties of Cement Sand Bentonite core Earth Dam.
- E.6.2 DRIP – Rehabilitation and improvements of basic facilities of Muvattupuzha Valley Irrigation Project – Malankara Dam.
- E.6.3 Investigation of Subsoil strata - Using Engineering Seismograph by Seismic refraction method -Construction of Check Dam across Bharathappuzha at Mannannur in Vaniyamkulam Panchayath
- E.6.4 Sedimentation survey of Karappuzha Reservoir using IBS and Sub Bottom Profile - Testing of Soil & Water samples
- E.6.5 Conducting Geophysical studies with Engineering Seismograph - Malampuzha reservoir
- E.6.6 Sedimentation survey of Karappuzha Reservoir using IBS and Sub Bottom Profile - Testing of Soil & Water samples
- E.6.7 Testing of Soil samples with additives in connection with Thesis For M-tech Project of Smt. Vimala C. A., Executive Engineer, P. V. I. P., Perumbavoor.
- E.6.8 Testing of Soil samples with additives in connection with Thesis for M-tech Project of Smt. Sujatha C., Prayag, S. R. M. Road, Kochi - 18.
- E.6.9 Testing of Soil sample for the construction of Lulu hotel and Convention centre.

- E.6.10 Testing of water samples - Moorikadavu SHE Scheme Silt analysis of river water by Investigation Division KSEB, Padinjarathara, Thariode P.O., Wayand.
- E.6.11 Testing of Soil samples with additives in connection with Thesis for M-tech Project of Smt. Vimala C. A., Executive Engineer, P. V. I. P., Perumbavoor. Second phase started on 10/08/2016.
- E.6.12 Testing of Soil samples - Construction of Mulayam Lift Irrigation Scheme in Nadathara Panchayath.
- E.6.13 NABARD - RIDFXVI - Construction of regulator cum bridge at Puappillikkavu across Periyar River in Ernakulam District. Testing of Soil Samples.
- E.6.14. KRP - LBC - Panjareveedu branch canal- Conducting Trial Boring.
- E.6.15 Conducted Soil Investigation on D/S of the Bavikkara Regulator across Payaswini River in Kasaragode District.
- E.6.16 Requisition for finding the properties for slurry - Southern Rock & Aggregate Mining company - Cheruthuruthy, Thrissur.
- E.6.17 Geo-Technical investigation works for Cochin Shipyard Ltd.
- E.6.18. Testing of specimen soil sample of Pattisserry Dam
- E.6.19 Testing of soil sample for Electro Kinetic Stabilization - Final Year Project of BTech.
- E.6.20 Testing of soil sample for Consolidation – MTech thesis of Smt. Varsha Paul.

Appendix – V**Times and Places of observation**

Serial No.	Month	Date of observation
1.	April	07/04/2016
2.	May	06/05/2016
3.	June	04/06/2016
4.	July	04/07/2016
5.	August	02/08/2016
6.	September	01/09/2016
7.	September	30/09/2016
8.	October	30/10/2016
9.	November	29/11/2016
10.	December	29/12/2016
11.	January	27/01/2017
12.	February	26/02/2017
13.	March	28/03/2017

Appendix-VI**Details of Simultaneous Observations**

Sl. No.	Name of Station	Time and C. P. Nos.				
		9 AM	10 AM	11 AM	11.45 AM	12.30 PM
1	Vettukadu	112	114	116	114	112
2	Anjengo	223	228	233	228	223
3	Eravipuram	317	322	327	322	317
4	Thottappilly	597	600	602	600	597
5	Alapuzha	704	707	710	707	704
6	Thankay	926	930	935	930	926
7	Kannamaly	1025	1037	1047	1037	1025
8	Kuzhupilly	1140	1147	1149	1147	1140
9	Perinjanam	1269	1274	1279	1274	1269
10	Nattika	1323	1330	1333	1330	1323
11	.Blangad	1418	1421	1428	1428	1418
12	Vakkad	1595	1599	1605	1599	1595
13	Calicut	1830	1826	NCP	1826	1830
14	Melady	2013	2009	2004	2009	2013
15	Thalassery	Back of Bishop's house	1067	1075	1067	Back of Bishop's house
16	Kanhangad	2608	2603	2598	2603	2608
17	Kasargod	531	541	550	541	531
18	Kanwatheertha	103	111	121	111	103

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