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, Thrissur

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

IV Executive Engineer, Quality Control Division, Thrissur

1. Quality Control Sub Division, Kannur
2. Quality Control Sub Division, Kozhikkode
3. Quality Control Sub Division, Palakkad
4. Quality Control Sub Division, Thrissur
5. Quality Control Sub Division, Muvattupuzha

V Executive Engineer, Quality Control Division, Kottarakkara

1. Quality Control Sub Division, Kottyam
2. Quality Control Sub Division, Alappuzha
3. Quality Control Sub Division, Kottarakkara
4. Quality Control Sub Division, Thiruvananthapuram

The first three divisions are doing 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 18 sections, under 9 Sub divisions, at Thiruvananthapuram, Kollam, Kottarakkara, Pathanamthitta, Allappuzha, Idukki, Kottayam, Aluva, Moovattupuzha, Koothattukulam, Angamaly, Thrissur, Palakkad, Malappuram, Kozhikode, Kalpetta, Kannur and Kasaragod.

2. PERSONNEL

The Executive officers who headed the various offices under KERI during the financial year 2019-20 are:

DIRECTORATE OF FUNDAMENTAL & APPLIED RESEARCH		
DIRECTOR	:	Er. Jamaludheen C.A. from 30/8/2018 to 02/07/2019
		Er. Rama M. from 03/07/2019 AN 10/07/2019
		Er. Mini Raju Sebastian from 11/07/2019 FN to 18/11/2019 FN
		Er. Alis Thomas from 18/11/2019 FN to 31/05/2019
ASSISTANT DIRECTOR		Er. NaveenC.L. (from 20/02/2019 FN Onwards)
JOINT DIRECTOR, CONSTRUCTION MATERIALS & FOUDATION ENGINEERING		
JOINT DIRECTOR	:	Dr. Santhosh Kumar P.T. (From 01/04/2019 to 20/12/2019)
		Er. Rema M. (FAC) from 25/06/19 to 04/07/19
		Er. Bimol Abraham. from 5/07/19 to 31/08/2019
		Er. Rema M (FAC) from 1/09/19 to 15/09/19
		Er. Bimol Abraham. from 16/09/19 to 17/09/2019
		Er. Rema M. (FAC) from 18/09/19 to 18/11/19
		Er. Beena Thankam 25/11/19 to 18/12/19
		Er. Rema M (FAC) from 19/12/19 to 25/12/19
		Er. Poorna S.Y. from 26/12/19 to 05/01/2020
		Er. Rema M. (FAC) from 06/01/2020 to 10/01/2020
		Er. Poorna S.Y. from 13 /01/2020 to 14/01/2020
		Er. Rema M. (FAC) from 15/01/2020 to 25 /01/2020
		Er. Poorna S.Y. from 27/01/2020 to 29/02/2020

		Er. Poorna S.Y. from 11/03/2020 to 03/07/2020
		Er. Saji Samuel from 04/07/2020 to 20/08/2020 FN
		Er. Beena N 20 /08/2020 (AN) onwards
ASSISTANT DIRECTOR	:	Er. Joyal Scaria. from 1/04/19 to 18/07/19
		Er. Smityha VR from 19/07/19 onwards
CONSTRUCTION MATERIALS DIVISION		
DEPUTYDIRECTOR		Dr. Santhosh Kumar P. T. From 15/12/2018 to 20/12/19
		Er. Mini T.M.(Full additional charge from 21/12/2019 to 31/03/2020)
ASSISTANT DIRECTOR I	:	Er. Siji T.V. (from 01/04/2019 to 07/08/2019)
		Er. Saju Varghese Full additional charge from (08/08/2019 to 10/08/2019)
		Er. Siji T.V. (From 10/08/2019 to 17/11/2019)
		Er. Nisha Antony. Full additional charge from (18/11/2019 to 28/11/2019)
		Er. Siji T.V. (From 28/11/2019 to 13/12/2019)
		Er. Joyal Scaria (Full additional charge from (13/12/2019 to 23/12/2019)
		Er. Siji T.V. (From 23/12/2019 to 31/03/2020)
ASSISTANT DIRECTOR II	:	Er. Lekshmy Suresh (From 01/04/2019 to 30/04/2019)
		Er. Siji T.V. (Full additional charge from 01/05/2019 to 07/08/2019)
		Er. Saju Varghese (Full additional charge from 08/08/2019 to 06/09/2019)
		Er. Siji T.V. (Full additional charge from 07/09/2019 to 25/09/2019)
		Er. Nisha Antony(Full additional charge from 26/09/2019 to 12/11/2019)
		Er. Lekshmy Suresh (From 12/11/2019 to 13/11/2019)
		Er. Nisha Antony Full additional charge from (13/11/2019 to 09/01/2020)
		Er. Siji T.V. Full additional charge from (10/01/2020 to 31/01/2020)
		Er. Rappai V.V. (From 31/01/2020 to

		31/03/2020)
SOIL MECHANICS AND FOUNDATIONS DIVISION		
DEPUTYDIRECTOR	:	Er. Miny T.M. (from 01/04/2019 to 06/07/2019)
		Er. Joyal Scaria (Addl.Charge from 07/07/2019 to 17/07/2019)
		Er. Miny T.M. (from 18/07/2019 onwards)
ASSISTANT DIRECTOR I	:	Er. Joyal Scaria (from 01/04/2019 to 31/03/2020)
ASSISTANT DIRECTOR II	:	Er. Joyal Scaria (Addl. charge from 01/04/2019 to 30/05/2019)
		Er.Valsalakumary V. R. (from 31/05/2019 FN to 31/05/2019 AN)
		Er. Joyal Scaria (Addl. Charge from 01/06/2019 to 31/07/2019)
		Er.Valsalakumary V. R. (from 01/08/2019 to 22/09/2019)
		Er. Joyal Scaria (Addl. Charge from 23/09/2019 to 31/10/2019)
		Er.Valsalakumary V. R. (from 01/11/2019 to 02/12/2019)
		Er. Joyal Scaria (Addl. Charge from 03/12/2019 to 22/12/2019)
		Er.Valsalakumary V. R. (from 23/12/2019 to 26/12/2019)
		Er. Joyal Scaria (Addl. Charge from 27/12/2019 to 31/12/2019)
		Er.Valsalakumary V. R. (from 01/01/2020 to 01/02/2020)
		Er. Joyal Scaria (Addl. Charge from 02/02/2020 to 18/03/2020)
		Er.Valsalakumary V. R. (from 19/03/2020 FN to 19/03/2020 AN)
		Er. Joyal Scaria (Addl. Charge from 20/03/2020 to 31/03/2020)
INSTRUMENTATION DIVISION		
DEPUTY DIRECTOR	:	Er. Sheeja A Andezhathu upto 28/05/2019
		Dr. Santhosh Kumar P.T. (From 29/05/2019 to 20/08/2019)
		Er. Jisha A. from 21/08/2019 FN to 07/09/2019 AN

		Er. Miny T.M. (full additional charge from 07/09/2019 AN to 28/10/2019 FN)
		Er. Saji Samuel (from 28/10/2019 FNonwards
ASSISTANT DIRECTOR	:	Er. Saju Varghese upto 06/09/2019 AN
		Er. Joyal Scaria (Full Addl. Charge from 06/09/2019 to 13/11/2019)
		Er. Smija K.M. (from 13/11/2019 FN to 23/01/2020)
		Er. Joyal Scaria (Full Addl. Charge 23/01/2020AN
		Er. Sreedev M.S.(from 24/01/2020 onwards)
PUBLICATIONS DIVISION	:	Post Abolished
JOINT DIRECTOR, HYDRAULIC RESEARCH		
JOINT DIRECTOR	:	Er. Rema M. (From 01/04/2019 to 31/03/2020)
ASSISTANT DIRECTOR		Er. Joy C.C. (from 01/04/2019 to 31/03/2020)
HYDRAULICS DIVISION		
DEPUTY DIRECTOR		Er. SuhurbanBegumV (from 23/11/2018 FN onwards)
ASSISTANT DIRECTOR I		Er. Jacob P V (from15/11/2018 FN onwards)
ASSISTAT DIRECTOR II		Er. Nisha Antony (from 25/01/2019AN onwards)
SEDIMENTATION DIVISION		
DEPUTY DIRECTOR		Er.Shini K.K.
ASSISTANT DIRECTOR I		Er. Dhanya K.S. (from 19/01/2019 to 14/01/2020 AN)
		Er. Francy V Antony (from 15/01/2020 onwards)
ASSISTANT DIRECTOR II		Er. Roshni S.S.
COASTAL ENGINEERING DIVISION		
DEPUTY DIRECTOR		Er.DeepaR. from 01/04/2019 to 06/08/2019
		Er. Sandhya T.from 31/10/2019 to 11/11/2019

		Er.Sunandakumary T.C. from 18/11/2019 to 23/02/2020
ASSISTANT DIRECTOR I		Er. Sufeera O.B. from 01/04/2019 onwards
ASSISTANT DIRECTOR II		Er.Sufeera O.B. from 01/04/2019 to 29.07.2019
JOINT DIRECTOR, CEFS		
JOINT DIRECTOR	:	Er. Prema C.K.
ASSISTANT DIRECTOR		Er. Anitha B. Nair
		Er. AjanthaV.D. (Full additional charge from 31/07/2019 to 14/11/2019)
		Er. Ushakumari. B (From 14/11/2019 onwards)
C.E. SUB DIVISION KOLLAM		
DEPUTY DIRECTOR	:	Er. Anjana.S
C.E. SECTION, TRIVANDRUM		
ASSISTANT DIRECTOR	:	Er. Ajin Singh S
C.E. SECTION, KOLLAM		
ASSISTANT DIRECTOR	:	Er. Shillar S.J.
C.E. SECTION, THOTTAPPALLY		
ASSISTANT DIRECTOR	:	Er. Santhosh kumar C.
C.E. SUB DIVISION, ERNAKULAM		
DEPUTY DIRECTOR	:	Er. SandhyaT.(01/01/2019 to 05/08/2019)
	:	Er. RajeshT.K. (From 06/08/2019 onwards)
C.E.S. SECTION, ERNAKULAM		
ASSISTANT DIRECTOR	:	ER. Jisha A. (01/01/2019 to 17/08/2019)
	:	Er. AnusreeA. (17/08/2019 to 27/08/2019 (Maternity leave availed from 27/08/2019 to 22/02/2020)
	:	Er.AnjuG. (27/08/2019 to 13/11/2019) Full Additional Charge
	:	Er. AjanthaV.D. (13/11/2019 to 31/12/2019 Full Additional Charge)
C.E. SECTION, CHERTHALA		
ASSISTANT DIRECTOR	:	Er. Anju G. (01/01/2019 to 13/11/2019)

	:	Er. Ajantha.V.D (Full additional charge from 13/11/2019 to 31/12/2019)
C.E. SECTION, CHAVAKKAD	:	Er. AjanthaV.D.
COASTAL EROSION STUDIES, SUB DIVISION, KOZHIKODE		
DEPUTY DIRECTOR	:	Er. Govindanunny V.K.
C.E.S. SECTION, KOZHIKODE		
ASSISTANT DIRECTOR	:	Er. Abdul Rasheed K.P.
C.E.S. SECTION, THALASSERY		
ASSISTANT DIRECTOR	:	Er. Anil KumarP. (01/07/2019 to 31/07/2019 Voluntarily Retired)
	:	Er. Abdul RasheedK.P. (01/01/2019 to 30/06/2019, 01/08/2019 onwards) In charge
C.E.S. SECTION, PARAPPANANGADI		
ASSISTANT DIRECTOR	:	Er. Abdul Rasheed K.P. (01/01/2019 to 23/10/2019) In charge
		Er. Ammad P.C. (24/10/2019 onwards)
QUALITY CONTROL DIVISION, THRISSUR		
EXECUTIVE ENGINEER	:	Er. Sajithkumar K.R.
		Er. Jayarajan Kaniyeri (from 10/07/2019 onwards)
ASSISTANT EXECUTIVE ENGINEERS		
Q.C. DIVISION, THRISSUR	:	Er.Sita Thankam V.(up to 06/08/2019)
		Er. Deepa R. (from 07/08/2019 onwards)
Q.C. SUB DIVISION, MUVATTUPUZHA	:	Er. Shaju Peeter (from 26/11/2018)
		Er. BinduR.(from 16/08/2019 to 16/11/2019)
		Er. Kamal Roy. K.V (from 16/11/2019 onwards)
Q.C. SUB DIVISION, THRISSUR	:	Er. Suguda kumari K.R. (from 11/10/2018 30/06/2019)
		Er. Babu M.S. (in charge from 01/07/2019 to 31/07/2019)
		Er. Babu M.S. from 01/08/2019 onwards
Q.C. SUB DIVISION, PALAKKAD	:	Er. Sivakumar V. (from 10/10/2018 to 03/08/2019)
		Er. Sulaiman M. (in charge from 04/08/2019

		to 04/12/2019)
		Er. Sudhakaran T.S. (from 04/12/2019 onwards)
Q.C. SUB DIVISION, KOZHIKODE	:	Er. Bindu P.B. (from 15/07/2015 to 20/08/2019)
		Er. Rajjev B. (from 20/08/2019 onwards)
Q.C. SUB DIVISION, KANNUR	:	Er. Aravindakshan V. (from 1/12/2018 onwards)
ASSISTANT ENGINEERS		
Q.C. SECTION-1, MUVATTUPUZHA	:	Er. Prasanna A.A.(from 24/05/2017 to 31/05/2020)
		Er. AnilaK.T.(in charge from 01/06/2020 to 21/07/2020)
		Er. Gopu N.(from 21/07/2020 on wards)
Q.C. SECTION-2, KOOTHATTUKULAM	:	Er. Anila K.T.(from 18/01/2017 on wards)
Q.C. SECTION-3, ANGAMALY	:	Er.Krishnakumar K.C. (from 01/04/2019 to 31.1.2020)
		Er. Anila K.T. (in charge from 31/01/2020 AN to 20/03/2020 FN)
		Er.Valsalakumary V.R.(from 20/03/2020 onwards)
Q.C. SECTION, THRISSUR	:	Er. Babu M.S.(from 19/02/2014 to 01/08/2019)
		Er. Mariya Jacob (in charge from 01/08/2019 to 16/11/2019)
		Er. Prasanna A.A.(in charge from 16/11/2019 to 01/01/2020)
		Er. NirishP.P.(in charge from 01/01/2020 onwards)
Q.C. SECTION, ERNAKULAM	:	Er. Mariya Jacob (from 26/10/2018 to 16/11/2019)
		Er. Prasanna A.A. (in charge from 16/11/2019 to 09/01/2020)
		Er. Pathuvai P.M.(from 10/01/2020 onwards)
Q.C. SECTION, PALAKKAD	:	Er. Leela C.V. (Retired on 31/04/2019)
		Er. SulaimanM.(in charge from 01/05/2019)
Q.C. SECTION, MALAPPURAM	:	Er. Sulaiman M. (from 31/10/2018 onwards)

Q.C. SECTION, KOZHIKODE	:	Er. Girish kumarK. (from 14.11.2019 onwards)
Q.C. SECTION, WAYANAD	:	Er. NirishP.P.(from 01/10/2019 on wards)
Q.C. SECTION, KANNUR	:	Er. Madhu K.P.(Retired on 31/05/2020)
		Er. Girish kumarK.(in charge from 01/06/2020 on wards)
Q.C. SECTION, KASARKODE	:	Er. MadhuK.P.(in charge from 03/06/2019 to 31/05/2020)
		Er. Girish kumar.K (in charge from 01/06/2020 on wards)
QUALITY CONTROL DIVISION, KOTTARAKKARA		
EXECUTIVE ENGINEER	:	Er. Anil Kumar V. (from 22/03/2019 to 31/05/2019 (Rtd.))
		Er. Jolly Susan Cheriyan (Addl. Charge from 01/06/2019 to 08/07/2019)
		Er. Abdul Manaf H. (from 08/07/2019 to 31/05/2020(Rtd.))
		Er. Jolly Susan Cheriyan (Addl. Charge from 01/06/2020 to 14/07/2020)
		Er. Sindhu R. (from 15/07/2020 onwards)
ASSISTANT EXECUTIVE ENGINEERS		
Q.C. SUB DIVISION, KOTTARAKKARA	:	Er.Jolly Susan Cherian (from 10/10/2018 to 14/07/2020AN)
		Er. MayaC.V.,Assistant Engineer(In Full Addl. charge from 14/07/2020AN to 06/08/2020AN)
		Er. Deepa B., Assistant Engineer(In Full Addl. charge from 06/08/2020AN to 12/08/2020FN)
		Er. Sheeja Panicker.P.K, Assistant Engineer (in Full Addl. charge from 12/08/2020AN to 03/09/2020FN.
		Er. Laly S.S., Assistant Executive Engineer From 03/09/2020FN to 04/09/2020AN. (on leave from 07/09/2020 to 01/10/2020)
		Er. Sheeja PanickerP.K., Assistant Engineer (in Full Addl. charge from 5.9.2020FN and still continuing
Q.C. SUB DIVISION, ALAPPUZHA	:	Er. Sabu C.D.
Q.C. SUB DIVISION, TVPM	:	Er. Beena K.R. (from 17/09/2018 to

		31/01/2020)
		Er. S Aswani Kumar (from 01/02/2020 onwards)
Q.C. SUB DIVISION, KOTTAYAM	:	Er. Merin Thomas (from 07/09/2020 onwards)
ASSISTANT ENGINEERS		
Q.C. SECTION, KOTTARAKKARA		Er. Maya C.V. (from 25/10/2018 to 06/08/2020AN)
		Er. DeepaB. (from 06/08/2020AN to 12/08/2020FN)
		Er. SheejaPanickerP.K. (from 12/08/2020FN and still continuing)
Q.C. SECTION, ALAPPUZHA		Er. Latha Kumari K.
Q.C. SECTION, PATHANAMTHITTA		Er. Sindu K.S.
Q.C. SECTION, TVPM	:	Er. Prasanna S. (from 1/04/2018 to 31/05/2019)
		Er. Deepa B.(Addl. charge from 01/06/2019 to 04/09/2019)
		Er. Renjini Gopinath (from 05/09/2019 onwards)
Q.C. SECTION, KOLLAM		Er.Deepa B. (from 26/10/2018 onwards)
Q.C. SECTION, KOTTAYAM		Er. Manjusha N.K. (from 01/01/2016 to 04/08/2020)
Q.C. SECTION, IDUKKI		Er. Aravind G.

3. HUMAN RESOURCES

The human resources of KERI compriseof both technical and non-technical personnel. During its prime, majority of the engineers working in KERI were post graduates in different disciplines of Civil Engineering.Thenumber of fundamental researches wascarried 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 fourteenposts of Assistant Engineers,Onepost are lying vacant.The number of supporting technical staff in the category of draftsman is Twenty Oneagainst a sanctioned strength of twenty-five.In the workers category, as it happens to be a vanishing category, just two workersare 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.Thevacancy position of KERI is attached as Appendix – I.

4. FUNCTIONING OF THE INSTITUTE

The Kerala Engineering Research Institute consists of seven divisions functioning atPeechi 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 works on Major Irrigation and Hydro electric project in the state are undertaken only after doing model studies/research studies by this division. 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.

Weather observations from Meteorological station are necessary to improve meteorological services in the state and enhance predictive capability of short and long term information for weather forecast and climatic changes. They are used for the real time preparation of weather analysis, forecasts and serve weather warnings, for the study of climates, for local weather dependent operations, for hydrology and agricultural meteorology and for research in meteorology and climatology. A meteorological station is functioning at Peechi dam site under the jurisdiction of this Division. It is located on the west bank of Peechi dam, near

Peechi House at latitude of 10° 31' 30'' N,longitude 76° 21' 59'' E and height above MSL + 96.03 m. From the station measurements of weather parameters such as Atmospheric pressure, Temperature (Min.& Max),Humidity, Rainfall, Evaporation,Wind speed,Wind Direction and Sunshine are taken and recorded daily at 8.30 AM.The monthly weather data as obtained is submitting to the Joint Director, Director and SE, FSC,Thrissur on every month.The study of rainfall and evaporation for the last 25 Years was conducted earlier.The graph of rainfall and temperature during the period from 1980 to 2018 has prepared at this office. An automatic weather station is also there in meteorological station for collecting data in every 30 minutes.The routine works of Hydraulics office, lab, meteorological station, Keralamodel area I and II are carried out in every year.

For the De siltation of dams, Qualitative analysis study of sediment of Chulliyar,Kuttiyadi, Kallada, and Neyyar dams are comes under this division. Qualitative analysis study of sediments of Chulliyar dam was completed in all respects and report submitted to government. The estimate for de-siltation study of other dams were submitted to government for AS. The work will be started soon after obtaining AS.Calibration of notches from various dams in Kerala is to be done under this division.

There are two Model Area under this division which includes a number of models. The maintenance work of this model area are done by this division. If the models in these model areas are properly maintained, it will help the students to study about dams and also increase the tourism possibility.

The 3D Model of Kerala and building housing model under this division is a three dimensional model of Kerala and it is a center of attraction in Peechi with lot of people visiting there.The current meter calibration was stopped here in KERI long years ago. The channel for calibration is completely damaged. An estimate for the civil work of the renovation of channel for current meter is already prepared and submitted for AS. Doing the renovation work, calibrationof current meter is to be done at KERI,itself avoiding the dependence of other state for this. The duty of operating internet Infrastructure facilities of all offices in KERI is entrusted for this office.

A.2. Activities for the year 2019-20

- ***Maintenance of Hydraulics Division Office***
- ***Revival of Physical Model study***
- ***Upgradation of Computer System capacity augmentation Improvement of Infrastructure yearly charges***
- ***Routine works of Hydraulics Division Office and Meteorological station for the year 2019-2020***
- ***Maintenance of Model area I & II of Hydraulics Division for the year 2019-2020***
- ***Upgradation of Meteorological station for the year 2019-20 -Purchase of new instrument***
- ***Calibration of notches for the year 2019-20***
- ***Routine maintenance of Kerala Model and building housing model***
- ***Urgent maintenance and Artistic paintingof Kerala Model***
- ***Renovation of Calibration tank for the calibrating current meter***
- ***Revival of Model Area***
- ***De Siltation of Kallada, Neyyar, Kuttadi and other Dams***
- ***Physical Model Study of Dams***
- ***Revival of Hydraulic Experimental Set up. Model Study of Stilling Basin of Kuttiyadi Dam***
- ***Physical model study of Pattissery Dam***

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.TheMeteorological Station under K E R I, Peechi is located on the west bank of Peechi Dam, near the Peechi House at a Latitude of 10º 31'30" N, Longitude 76º 21' 59" E

and height above MSL +96.03 m.

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.

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 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. These data can be accessed via, internet using a software HYDRAS. The data collected can be used to gauge current weather conditions and to make weather forecasts like temperature high/lows, cloud cover and the probability of precipitation.

Components of Automatic Weather Station

i) Ultrasonic Wind speed and Direction sensor& Compass
ii) Global Radiation Sensor
iii) Temperature, Humidity, Barometric Pressure Sensors
iv) Rain Gauge
v) Data Logger

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A.2.1.2Manual Weather Station

Manual measurements of meteorological data are done using 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.

Bimetallic Thermograph

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

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 thermosphere.The instrumentused for measuring humidity are Psychrometer (Dry&Wet bulb) & HairHygrometer.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 ofthe 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.

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 type's 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.

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.

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.

Wind Direction& Wind speed

Observations or measurements are required for weather monitoring and forecasting,wind-loadclimatology, 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 kilo meters per hour.

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 sunshinerecorders 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.

PSYCHROMETER

HAIR HYGROMETER

BIMETALLIC THERMOGRAPH

FLOAT TYPE SELF RECORDING RAIN GAUGE

STANDARD RAIN GAUGE

LANDPAN EVAPORIMETER

WIND VANE

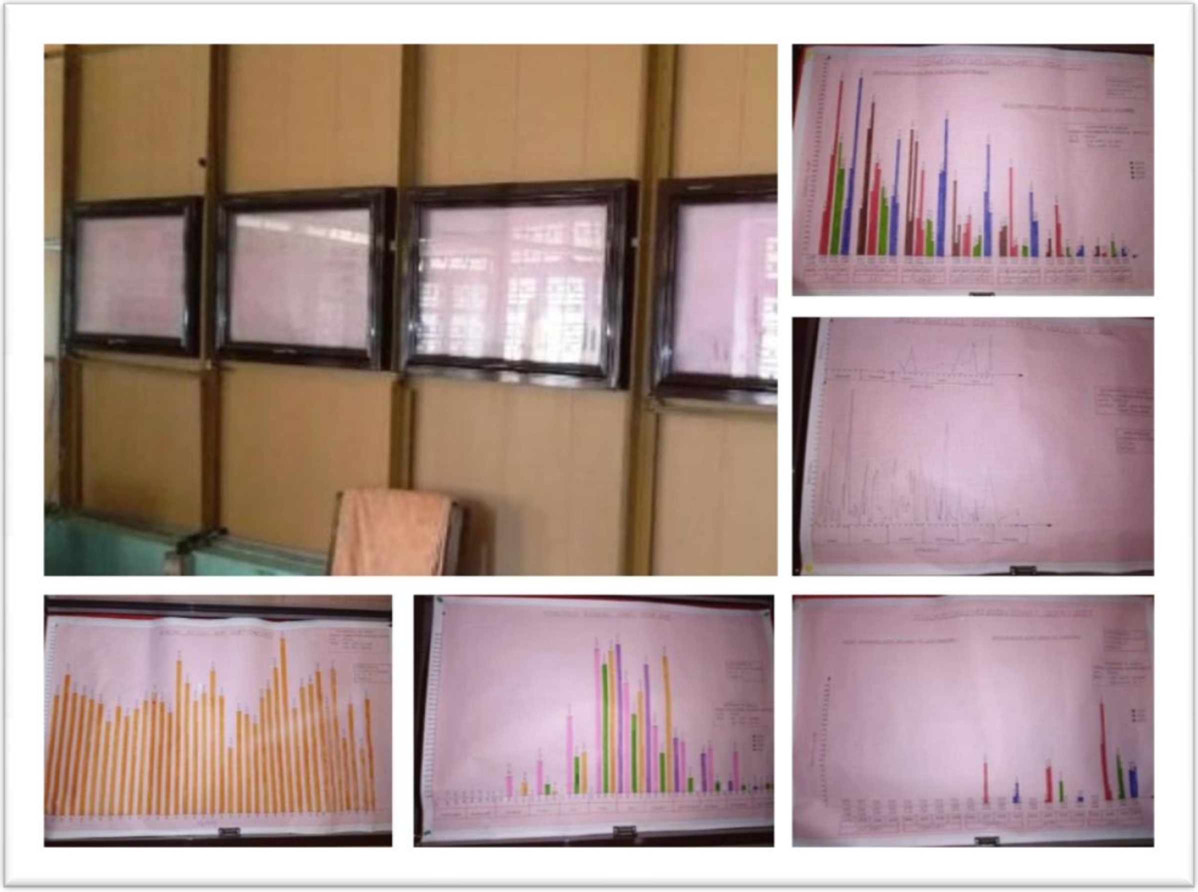
CUP ANEMOMETER

SUNSHINE RECORDER

An abstract of the Weather data collected from Weather Station for the period from April 2019 to March 2020 is given below

Abstract of the weather data from April 2019 to March 2020
Latitude- 10^{o} 31' 30" N Longitude- 76^{o} 21'59" E MSL- +96.03 M.

Sl.No	Weather Elements	Range of the weather data
1.	Temperature	The maximum temperature was 40.5^{o}C in March 27th-2019 and the minimum temperature was 22^{o}C in 11th December -2019
2.	Relative Humidity	The relative humidity at 8.30 AM observation time varies from 96% to 63% during the calander year 2020
3.	Precipitation	Annual rainfall was **3249.9**mm (for the calendar year 2019) and the maximum monthly rainfall was 990.3mm in August 2019 and minimum monthly rainfall 6.6mm in December 2019.During January, February, March has not obtained any rainfall.
4.	Wind-Direction	The main wind directions observed were from South East and North East directions.
5.	Wind Speed	Maximum daily mean wind speed was 11.6 km/hr in November 23rd 2019 and minimum daily mean wind speed was 0.2 km/hr in July 7th2019.
6.	Atmospheric pressure	Barometer and Automatic weather station are out of order during this period. Hence data not available.
7.	Evaporation	Maximum Evaporation was 8mm in February 2019.
8.	Sunshine Recorder	The duration of bright sunshine was 10.30 Hours to 0.0 Hours during calendar year 2020.



Graph for temperature, Annual Rain Fall,10 days Chart for rainfall,Monthly Chart for Rain fall and etc.

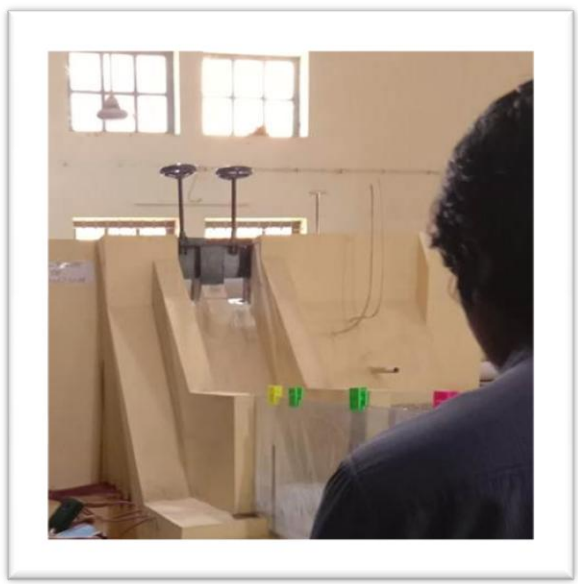
A.2.2. Model Study of Pattissery Dam

The Chief Engineer I&A had instructed KERI to conduct the model studies of stilling basin and river outlet work of Pattissery dam and we have collected the available details from IDRB required to fix the scale of the physical model. The terms of reference for the study, DPR, Topographic survey details and longitudinal and cross-sectional details of canals were provided to this office by November, 2017. As the division has not conducted any physical model studies for the past 15 years owing to different factors like retirement of experienced engineers in this kind of work from the department and the division lacks skilled labourers on regular appointment, proposal for a proper regular guidance from an expert was sought for executing the study. Experts in field as well as academic institutions were contacted for assistance and guidance with regard to physical as well as numerical model study.

In order to carry out the numerical modelling for Pattissery dam, the faculty at Government Engineering College, Thrissur were contacted to explore the possibility of engaging M.Tech students to do this study as their M.Tech thesis and give us the result based on the hydraulic details to be provided by us. Subsequently, a part of the numerical model study of Pattissery dam was entrusted to a PG student in GEC Thrissur (with Specific objectives of 2D and 3D analysis of the Pattissery dam spillway (revised design) for different spillway gate opening condition and optimization of the height of training walls in stilling basin by numerically stimulating the flow over the spillway and stilling basin using ANSYS FLUENT software) and 70% of that part of study was completed by 2018. To get the analysis of all the remaining parameters, faculty at GEC Thrissur agreed in principle to assign these objectives as M.Tech thesis work for their students in coming batches.

Proposals were also put up for physical model study in collaboration with CWPRS Pune, IRI Roorkee, NIT Calicut, NIT Surathkal and College of Engineering Trivandrum. The faculty at Department of Civil Engineering, College of Engineering, Trivandrum expressed willingness in collaborating with KERI and also agreed to act as subject experts for the revival of physical model studies at KERI.

There after vide order No.GO(Rt) No.578/2018/WRD dated 4/8/2018 government accepted the proposal of college of Engineering Trivandrum and MOU signed between KERI, Peechi, Department of Irrigation, Government of Kerala and centre for industrial training, consultancy and sponsored research, College of Engineering, Trivandrum on 18th September, 2018. The initial advance of Rs.8,49,600/- paid to CET by CE, IDRB, Trivandrum and they started the model preparation work. Firstly the model study of Spillway of proposed dam was conducted by preparing dam model at the ratio of 1: 30 of the Prototype and flow characteristics through spillway, stilling basin studied on model. The Interim report on “Model study of pattissery dam spillway and canal head works” obtained on 12th June, 2019 from CET and the same has submitted to IDRB Trivandrum. Now the model study on spillway, stilling basin are completed and remaining study on river sluice and canal sluice are still pending for want of more details from department.



A.2.3 Maintenance of 3D model of Kerala and the building housing the model

The Relief map of Kerala (Kerala model) at K.E.R.I. is a three-dimensional model of Kerala and it is a centre of attraction in Peechi, with lot of people visiting daily. Routine maintenance of the building had been done by this office regularly.Inaddition to this in this year, artistic painting of model and building was done by arranging a separate work through departmentally. 3D model of Kerala painted with colorful paints for each district and remark National Highway,State Highway,Railway Line and Rivers with suitable colors. Two display boards also wrote on walls of building displaying details of rivers in Kerala and Nation Highways passing through Kerala State.Now this building was rectified and beautified and allowing tourist to visit.


RELIEF MAP OF KERALA


കേരളത്തിലെ നദികൾ
പടിഞ്ഞാറോട്ടൊഴുകുന്നവ
കിഴക്കോട്ടൊഴുകുന്നവ

Kerala 3D Model after renovation

A.2.4 Upgradation of Computer System capacity augmentation Improvement of Infrastructure yearly charges

The Kerala Engineering Research Institute, Peechi complex consist of Director's office, Office of the Joint Director (Hydraulic Research), Office of the Joint Director (Construction Materials & Foundation Engineering), Office of Deputy Director (Sedimentation Division), Office of Deputy Director (Instrumentation Division), Office of Deputy Director (Coastal Engineering Division), Office of Deputy Director (Soil Mechanics & Foundation Division), Office of Deputy Director (Construction Materials Division) and Office of Deputy Director (Hydraulics Division) functioning in five buildings. The offices are engaged in various Research, investigation and quality ensuring activities and contribute to the Government in the form of revenue. The institute is also engaged in organizing training programs in the seminar hall of KERI Building. Various Government agencies, Private agencies and other institutions utilize the resources at KERI for ensuring quality in construction. Also, K.E.R.I. is in the process of accreditation from NABL which is expected to boost the status of the Labs and is likely to increase the revenue to Government. High speed and stable internet connection are essential for smooth functioning of these offices and their activities. Further, most of the processes of the Department are being switched over to the web platform. Thus, be it the estimation software (PRICE), or accounting software (BIMS/BAMS), employee transfer details (e-monitoring), plan expenditure and progress (PLANSPACE), salary software (SPARK), HRMS etc., all are web based and need uninterrupted andhigh-speed internet to work at optimum level. Thus, a stable and sufficiently speedy internet infrastructure is a bare necessity for an institute like KERI.

There were connectivity issues with the internet connection plans subscribed by the aforementioned offices which hindered the routine activities. Hence proposal was given for high speed internet connectivity from BSNL through FTTH with RF link including LAN cabling and UPS. The provisions in the estimate were given as per recommendations from the Principal General Manager, BSNL, Thrissur and the execution of the work was monitored and completed under the charge of this division during 2018.During financial year 2018-19 as an improvement to Infrastructure of FTTH connection of all offices of KERI,firewall protection given for regulation of BSNL FTTH internet usage and along this yearly plan charge remitted to BSNL by this Office. All the cable fault that occurred during the period were rectified by this office.

In this year 2019-20 all the cable fault works are rectified by arranging works through M/s.Quadri Technologies Aluva. Since sufficient balance with the FTTH connection yearly charges are not remitted to BSNL for this financial year. On assessing the internet usage of various offices of KERI for the past months, the Plan for FTTH connection changed to Plan 1277.

A.2.5 Calibration of Notches

Notches are used for measurement of discharge through open channels by placing or constructing them across the stream or channel. The discharge over notch is measured by measuring the head acting over the notch. The actual discharge and theoretical discharge will be equated using a suitable coefficient of discharge and a factor for the head of flow. The process of assessing these constants is called calibration. Once the equation relating discharge and head of flow over the notch is established by calibration experiment, the discharge at any point in a channel can be estimated by fixing the notch across the channel and measuring the head of flow.

Notches can be of different shapes such as triangular, rectangular, trapezoidal, stepped notch, etc. The bottom of the notch over which the water flows is known as crest or sill and the thin sheet of water flowing through the notch is known as nappe or vein. The edges of the notch are bevelled on the downstream side so as to have sharp-edged sides and crest resulting in minimum contact with the flowing fluid. As water approaches the notch, its surface becomes curved. Therefore, the head over the notch is to be measured at the upstream of the notch where the effect of curvature is minimum. Also, it should be close to the notch so that the loss of energy between head measuring section and notch is negligible. In practical, the head over notch is measured at a distance of 3 to 4 times the maximum head from the notch.

The notch calibration tank situated at outdoor Model Area I is generally used for the calibration of notches from received from various irrigation projects of Kerala. In this year we have not received any new notches for calibration.

A.2.6 Revival of Hydraulic Experimental Set up. Model Study of Stilling Basin of Kuttiyadi Dam

In order to restart model study work at KERI after years of gap, Cheif Engineer IDRB vide letter dated 30/04/18 directed to take up model study of stilling basin of Kuttiyadi Dam as a pilot project at KERI. For this consultation support of College of Engineering also sanctioned for Rs.2,00,000/- + 18% GST.The MoU had signed between CET and Director KERI on 06/05/2019 for this consultancy. As per MoU, 60% of consultation charge to be paid in advance for starting the consultancy and on 04/7/2019 CET submitted advance invoice for Rs 1,41,600/- (Rs.1,20,000/- + 18% GST) and CE IDRB paid an amount of Rs.1,27,440/- after deducting 10% income tax. Thereafter on 06/12/2019 Prof.Thulasidharan Nair B and Dr. P.G. Jayaraj visited KERI and examined available facility at lab and at model areas I and II. After discussing various possibilities to restart model study,Professors suggested to set up dam model at lab itself utilizing the overhead tank for water storage after maintenance.According to their expert opinion the estimate for revival of Physical model study prepared by this office. Unfortunately as we unable to execute this work during this financial year, further progress on this work not achieved.

A.2.7 De-Siltation of dams – Qualitative analysis of sediments

As a pilot project, for de-siltation of Chulliyar dam, qualitative analysis study of sediments at the dam which was interest to this office was completed by March, 2018. After that similar study at three more dams namely Neyyar, Kallada and Kuttyadi also entrusted to this office. Then by middle of 2018 the estimates of these three dams for sediment sample collection and its analysis study were prepared under the head of account of 4700-80-005-99-02-00-V (Investigation of Major irrigation scheme). The grid size adopted for the sediment sample collection was 50mx50m. After that on the empowered committee meeting convened on

02/11/18, as it was decided to change grid size to 200m x 200m instead of 50m x 50m for sediment sample collection, the estimates were returned to this office for correction by First week of Jan 2019 from CE, IDRB. Accordingly the estimates were corrected by reducing the provision for sample collection and othernecessary provisions and estimate resubmitted by this office by last week of January, 2019 with 0% provision.Then these estimates edited by higher offices by giving 12% provision for GST. As the FS for these works are not yet received, we cannot take up these works during 2019-20.

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 Kerala Engineering Research Institute itself. Several researches 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 ie, at Padinjare Vemballore and Anchangadi in Kodungallur Taluk have been 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.Leica GS14 has been upgraded to Leica GS 18T model in 2019-20. Leica GS 18T is the world's fastest GNSS RTK rover and is a part of the Leica Geosystems self-learning GNSS series.Presently this division is engaged in conducting topographical survey works for investigations related to Kerala Irrigation Department.

Works carried out by this division under the Head of account 4701-80-800-99-Development of KERI as action plan for the financial year 2019-20 consists of two types of works viz.(I) Fundamental studies using smart station (II)Routine works of Coastal Engineering Division.

B.2 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. Highlights of works taken up by this division during the year 2019-20 are as follows:

B.2.1 Establishing TBM with respect to Mean Sea Level at various stations in Thrissur Kole land in 2019-20

A Focus group for preparing action plan for water management activities in the Kole lands of Thrissur region under Haritha Keralam Mission was constituted as Director, KERI as convener as per Order No.PL2-20179/2019 dated:20/06/2019 of the Chief Engineer, Irrigation & Administration, Thiruvananthapuram. This work was taken up by this division as per the direction of Convener, Focus group for kole lands. Purpose of the work was to connect MSL at Enamakkal, Idiyanchira, Illikkal and Ettumuna regulators and Karanchira PWD Bridge near Munayam bund of Thrissur kolelands.

These stations were connected to MSL from the already established bench mark at Enamakkal regulator by this division.

B.2.2 Conducting topographic survey for construction of check dam across Thoothapuzha at Vilayur in 2019-20

This work has been done as per the request of the Executive Engineer, Minor Irrigation Division, Palakkad and as per the direction from Joint Director, Hydraulic Research, KERI, Peechi. The proposal was for the Investigation work of check dam across Thoothapuzha at Thonikadavu in Vilayur Panchayath. Thoothapuzha is a major tributary of Bharathapuzha which originates from Salient Valley Hills. Construction of a check dam at this site will considerably reduce the irrigation and drinking water scarcity of nearby Panchayaths. The work included fixing of position (ie., latitude and longitude) of these sites, connecting these sites with Mean Sea Level (MSL), preparing contour map, carrying out survey for finding the required cross sections (at 15.00m intervals for 60m upstream and downstream of site, at 50.00m interval for a length of 500.00m upstream, and 100.00m interval for remaining upstream and downstream) and longitudinal section of river and banks for designing the structure.

B.2.3 Conducting topographic survey for construction of check dam acrossThoothapuzha at Mundorssikadavu in Sreekrishnapuram Panchayath of Palakkad District in 2019-20

This work has been taken up by this division as per the request of the Executive Engineer, Minor Irrigation Division, Palakkad and as per the direction of Joint Director, Hydraulic Research, KERI, Peechi. The proposal was for the Investigation work of check dam across Thoothapuzha at Mundorssikkadavu in Sreekrishnapuram Panchayath of Palakkad District. To carry out the survey work, we used Smart Station. Scope of the work was fixing of position (ie. latitude and longitude) of these sites, connecting these sites with Mean Sea Level (MSL), preparing contour map and carrying out survey for finding the required cross sections (at 15.00m intervals for 60m upstream and downstream of site, at50.00m interval for a length of 500.00m upstream, and 100.00m interval for remaining upstream and downstream length) and longitudinal section of river and banks for designing the structure.

B.2.4 Conducting topographic survey for data collection associated with coastal model studies

The proposal was to conduct coastal survey for collecting data which can be used for various coastal model studies in future. On discussion with Dr.K.V.Thomas, Retd.Scientist NCESS (Member of Technical Committee to assess the feasibility of the proposal for construction of seawalls/gryones for protecting vulnerable reaches of Kerala sea coast), it was suggested to carry out survey at nearby critical locations. Sites selected include Kara-Eriyad coast and Vatanappally coast which are always facing worst sea attack, South of Kaipamangalam where mud banks were usually formed.As per the expert advice profile up to a depth of 20m in the sea has to be collected in order to use this data in coastal model studies. On the basis of above discussion it was decided to conduct survey for a length of 10km stretch (Eriyad-Kara 3.4km, Perinjanam- Kaipamangalam 3km and Vatanappally3.6km) as an initial phase. Same area had already been surveyed in 2018-19 also by this division. Hydrographic Survey has been conducted up to a distance of 2km inside the sea in 2018-19 in the same areas. Due to lack of fund hydrographic survey could not be conducted in this financial year. Topographic survey from CP stone to the shore line was conducted using Smart station and profiles were collected in these areas.

B.2.5 Checking the instrument for ensuring the measurement precision, accuracy and reliability of Leica GS-14 survey equipment of Coastal Engineering Division in 2019-20.

Smart Station is a new revolutionary surveying system that combines a high-performance Total station with a powerful GPS RTK receiver. With Smart Station there is no need to worry about control points, traverses and resections. Coastal Engineering Division possess the most compact and powerful GNSS receiver Leica Viva GS14.The integrated GSM mobile communications with removable SIM card and UHF radio modem means it is suited for any measuring task. As per suppliers of the instrument accuracy level of measurement are as follows. Real-time kinematic - Hz 8 mm + 1 ppm/V 15 mm + 1 ppm, Hz 8 mm + 0.5 ppm/V 15 mm + 0.5 ppm Single baseline Network RTK, Post processing - Hz 3 mm + 0.1 ppm/V 3.5 mm + 0.4 ppmHz 3 mm + 0.5 ppm/V 5 mm + 0.5 ppm Static (phase) with long observations. Measurement precision, accuracy and reliability of the instrument and the different methods are dependent upon various factors including number of satellites, geometry, obstructions, observation time, ephemeris accuracy, ionospheric conditions, multipath etc.

GPS and GLONASS can increase performance and accuracy by up to 30% relative to GPS only. Various error influences, particularly those relating to ionospheric delays, tropospheric delays and satellite orbits, affect the satellite signals and the data received. If the rover is close to the reference, the errors will be similar at both the rover and reference and will be largely eliminated by the differential RTK technique. The greater the distance between rover and reference, the more the errors will differ and the more difficult it becomes to eliminate them. It follows that, as the distance increases, a range will be reached at which RTK can no longer determine the position to centimeter-level accuracy. The work was to connect Survey of India bench marks at Shornur Police station and at Kuttippuram to a point at Pattambi which is nearly midway of the above two bench marks. We used both survey mode and static mode with long observation for the same.

B.2.6 Establishing TBM with respect to MSL at various stations in Attapady for the proposed new dam in 2019-2020

This work has been taken up as per the request of the Executive Engineer, AVIP, Bhavani Basin Division, Agali, Palakkad. The proposal was for transferring Bench mark (Survey of India B M) from Shoranur Police station to proposed Dam Site for the verification of several relevant mandatory details of the Detailed Project Report of Proposed Attappady Valley Irrigation Project, as per the MoWR norms & CWC guidelines.

Before the commencement of this work, the survey instrument was checked for its precision and accuracy by connecting Survey of India bench marks at Shoranur Police station and at Kuttippuram which are 42km apart. It was found that there is a slight shift in the Bench mark at Shoranur police station as it is not well protected. Hence AVIP site was connected with mean sea level using theSurvey of India Bench Mark at Kuttippuram which is very well protected.

B.2.7 Conducting topographical Survey for the Seetharkundu waterfall diversion scheme using smart station Stage II

Topographical survey for Seetharkundu waterfall diversion scheme Stage II was proposed as a part of Fundamental Studies using Smart Station for the year 2019-20. Almost 70% of survey work for the same scheme has already been completed in 2018-19. Technical Sanction for stage II work has been accorded on 22/03/2020, immediately after finalizing the additional area to be surveyed by the project authorities. As the Government declared complete lockdown in the nation due to COVID-19 Pandemic on 23/03/2020, the survey could not be conducted in 2019-20.

B.3 Routine works of Coastal Engineering Division

The works under this category include maintenance of office including maintenance of computers, purchase of essential consumables etc., maintenance of an outdoor model area which was used for physical model studies on Kerala Coast in past years, annual maintenance of Smart Station and for the purchase of accessories and any spare parts if required.

B.3.1 Routine activities of the Coastal Engineering Division office and the Offices of Director, F & AR and Joint Director, Hydraulic Research for the year 2019-20

This work had been included in the action plan for meeting the routine activities of this office and offices of the Director, F & AR and Joint Director Hydraulic Research. Maintenance and repairing of computer and related accessories, purchase of computer related items, maintenance of plumbing works, electric works, purchasing of stationary items and additional works that come up at any time etc., had been done in this year. Aluminium Partitions in the office of Joint Director, Hydraulic Research was done in this financial year. Electrical works in the renovated Director office was also included in this sub head.

B.3.2 Maintenance of the model area of the Coastal Engineering Division in 2019-20

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 and Engineering museum, overall upkeep of model sheds for keeping this area spick and span and also surroundings of Director’s office building had been done.

B.3.3 Annual Maintenance and purchase of accessories for Smart Station

This work is for the annual maintenance of Smart Station and for the purchase of accessories and any spare parts if required. As the Smart Station is sophisticated electronic equipment, annual calibration and maintenance are essential so as to ensure the accuracy of the position data given by the instrument. Provision is included in the estimate for Annual Maintenance Contract of the Total Station TS11. Service and recalibration of PENTAX Total Station R-205 NE was also included. PENTAX Total Station was transferred to this division from Soil Mechanics & Foundations Division, KERI. Batteries are one of the essential accessories for progressing the survey effectively. Any damage in batteries will delay the work. Hence as a precautionary measure, provision for purchase of additional batteries are included. Provisions are included for the purchase of car battery charger, cables and any other consumables if required in emergency. A lumpsum provision is also given for the purchase and maintenance of any spare parts of the instrument, consumables and miscellaneous items for survey if required in emergency. In between an investigation work, it was noted that the LCD display of CS 10 controller and Upper housing keypad were not functioning properly. Complete testing and servicing and software up gradation were done in order to progress the investigations effectively.

Apart from the above works, Investigation works under Head of account -4701-80-800-88-Formation of River Basin Organization, 4700-80-005-99- Investigation of Irrigation scheme and PW deposit work had also been carried out during the financial year 2019-20.

B.3.3.1 Works under the Head of account -4701-80-800-88-Formation of River Basin Organization

B.3.3.1.1 Upgradation of the existing survey instrument Leica GS14 to Leica GS 18T

This Division is entrusted with investigation works using Smart Station which is a new revolutionary surveying system in which total station and GPS are perfectly integrated and has conducted many topographical surveys related to the existing and proposed projects in Irrigation Department and has possession of one base and two Leica GS14 GPS RTK rovers. Leica GS14 has been upgraded to Leica GS 18T model during this financial year. Leica GS

18T is the world's fastest GNSS RTK rover and is a part of the Leica Geosystems self-learning GNSS series. Due to the tilt compensating function, it is not required to hold the survey pole in vertical position, that is there is no need to level the bubble for measuring and staking of points. In this the sensor accurately and reliably measures the pole tilt and together with RTK or Smart Link, provides an accurate tilt compensated position. Leica GS 18T is immune to magnetic disturbances, also calibration free.

Leica GS 18T is integrated with a new Cinterion cellular modem that supports LTE (4G) as well as all existing networks. In Leica GS 18T a self-learning GNSS sensor is being used, hence the best satellite signals and the best available correction data is chosen automatically thus achieving best possible position accuracy and quality. SmartLink and SmartLink fill are precise point positioning services that enable the sensor to provide precise measurements when the RTK correction service is unavailable.The measurement engine in GS 18T is ME7 (measurement engine generation 7). This gives an ultimate performance in GNSS positioning.

It includes latest features such as 555 channels, Multi-frequency, Multi constellation, L-band service etc. This sensor is supplied with most modern controller of Leica CS20 with specialized package software called Captivate. Captivate is the most field worthy software in the industry with more land survey features compared to CS10 controller GS18T also fitted with IMU based tilt sensor, so that no magnetic field can affect the poisoning. So this can work close to bigger concrete structures with larger reinforcement, Electrical installations etc.

B.3.3.1.2 Proposal for survey on Chandragiri River of Kasaragod district using Smart Station phase-II

First phase of survey of Chandragiri River of Kasargode for a length of 19km having an average width of 130m has been completed in the financial year 2015-16. The work was done under the Head of account A 4700-80-005-99-Investigation of Irrigation Schemes. Scope of the work was to take c/s at 100m interval including the survey of both banks at the same interval for a width of 50m each, upwards from the railway bridge (ie., approximately 1km from sea mouth).During 2016-17 nearly 11 km of the river u/s of last year's work towards Payaswini branch of Chandragiri river has been conducted under the same Head of account. As there was no action towards the fund request in 2017-18 and 2018-19 survey of remaining 75km length of the river could not be completed. Under these circumstances it was directed to submit the estimate for survey of remaining 75km of Chandragiri River under the Head of Account 4701-80-800-88-00-00-00-V Formation of river basin organization in 2019-20.

During the meeting held in the chamber of Chief Engineer, IDRB on 31/01/2020 regarding survey of Chandragiri River, officials from this office explained the bottle necks of the work. Since the work is progressing towards the upstream of river where it is flowing through a difficult terrain, the survey can be conducted only during non-monsoon period, i.e, the suitable working period is from December to May. Chief Engineer, IDRB instructed us to carry out the Survey as a Tender work so as to avail fund during the desirable working period and to complete the project satisfactorily. As per the direction work has been awarded as tender work. This survey is highly essential for the proposed Arattukadavu, Moonamkadavu, Chakkode, Kariath-Maramgavu check dams in Karicheri River and Kookangai, Erinhipuzha, Pallamgode, Chotta, Thonikadavu check dams in Payaswini River. This survey will help for planning Irrigation and other structures in Chandragiri River.

B.3.3.1.3 Sand Budgeting in Chaliyar River Basin

Director, KERI has submitted a proposal specifying the technical method by which an assessment of the quantity of sand available in the river bed, the quantity of sediments being deposited and hence the quantity that can be allowed for mining as per the direction of Chief Engineer, IDRB in 2017-18. The objectives of this study are (i) to ensure that sand and gravel extraction is carried out in a sustainable way (ii) to maintain the river equilibrium with the application of sediment transport principles in determining the locations, period and quantity to be extracted. Chaliyar which is one of the rivers which doesn't get dried up in the drought season was selected for the pilot study.Many other rivers in Kerala get dried up during March and April. Methodology followed for sand auditing are Mapping of the river channel, Ascertaining Pristine Condition of the Rivers, Sediment Sampling, Sediment Transport Model, Model Simulation, Result Analysis includes Sediment Spatial Plot, Sediment Time Series, Sediment Cross section Plot and Monitoring Plan. The mapping of the rivers can be performed by using modern equipments in Kerala Engineering Research Institute. River survey can be carried out by using Integrated Bathymetric System (IBS) and Sub bottom Profiler and banks can be surveyed by Smart Station. Since KERI is new to the field of Sediment Transport Modelling and this portion of the proposal is decided to outsource. NIT Kozhikode has already been involved in such studies. Our Institute had discussed with NIT Kozhikode and they expressed their willingness to collaborate with our Institution for a pilot study, which includes capacity building of our Engineers. MoU has been signed between Director, KERI and Director, NIT Calicut. Land use data, soil map and hydro meteorological data of Chaliyar river basin were collected and made available to the consultants and the work started.

B.3.3.2 Works under the Head of account 4700-80-005-99- Investigation of Irrigation Schemes

B.3.3.2.1 Conducting Topographic survey for investigation of Bharathapuzha irrigation Scheme in MuthuthalaPanchayath in 2019-20

Investigation of proposed Bharathapuzha Irrigation Scheme in Muthuthala Panchayath of Palakkad District has been taken up as per the request of the Executive Engineer, M.I.Division, Palakkad and as per the direction of Joint Director, Hydraulics Division, KERI. The Scheme is proposed to cater the irrigation needs of nearby paddy fields by pumping water from Pandarathodu of Muthuthala Panchayath which drains to Bharathapuzha. The work done were taking fly levels from the nearest G.T.S Bench Mark for bench mark transferring with respect to M.S.L to the site, Conducting topographic survey in stream and bank at cross sections in every 25m interval for entire length, Survey of paddy fields along the banks of Pandarathodu.


B.3.3.2.2 Conducting Topographic survey for assessing the sedimentation in Velliyamkallu RCB at Thrithala in 2019-20

This work has been taken up as per the request of the Executive Engineer, Chamravattom Project Division, Eswaramangalam and as per the direction of Director, KERI. The proposal was for assessing the sedimentation in Velliyamkallu regulator at Thrithala. The

Velliyamkallu RCB at Thrithala across Bharathapuzha in Palakkad District was commissioned during September, 2007.The main objective of the scheme is to stabilize 3997Ha of ayacut pertaining to 8 lift irrigation schemes in Pattambi Taluk and ensure an assured source of drinking water facilities to the adjoining 25 Panchayaths and 4 Muncipalities comprising in both Palakkad and Thrissur Districts. Now the capacity of the scheme was reduced considerably due to the sedimentation of sand/soil due to the severe flood occurred in August, 2018. Increasing of the water carrying capacity of the reservoir is highly essential to mitigate the severe drought situations etc., for which this study is proposed. Integrated Bathymetric Survey cannot be done as there was not enough draft for the survey boat. Hence it was decided to conduct the survey using Smart station. The survey extended for a length of nearly 9km up to Pattambi Bridge.

B.3.3.3 Works under the Head of account 8443-00-108-00-00-00 -PW Deposit

B.3.3.3.1 Investigation work for construction of Check Dam cum Foot Bridge across Kalpathy River

This work has been taken up as per the request of the Assistant Executive Engineer, M.I. Subdivision, Palakkad and as per the direction of Joint Director, Hydraulic Research. The investigation was carried out for construction of a Check Dam cum foot crossing bridge across Kalpathi River in ward No.1 at Kunnumpuram in Palakkad Muncipality. The Check dam was proposed to cater the ground water recharge for the surroundings, washing and drinking purpose for the people at nearby Madhuveeran colony. The foot crossing bridge was proposed for the devotees to reach the temple, where there is no road to reach the temple except crossing the river. The temple is surrounded by river on all its sides. Scope of the work was fixing of position (ie. latitude and longitude) of these sites, connecting the site with Mean Sea Level (MSL), preparing contour maps and carrying out survey for finding the required cross sections (at 15.00m intervals for 60m upstream and downstream of site, at50.00m interval for a length of 500.00m upstream, and 100.00m interval for remaining upstream and downstream length) and longitudinal section of river and banks for designing the structure. Work could not be completed as there was some complex issues for the project authorities in finalizing the location of check dam.

B.3.4 Works under the Head of Account 2701-01-101-98-00-18-V-Maintenance-Peechi Scheme

B.3.4.1 Renovation works of the Coastal Engineering Division office and the Offices of Director, F & AR and Joint Director, Hydraulic Research

The work was proposed by the verbal direction of the Director, F & AR, KERI, Peechi for the rearrangement of the office of the Director, F & AR and Joint Director, Hydraulic Research. Some maintenance works and additional works were proposed. Room for the office staff of the Director's office was so small to accommodate the administrative branch and drawing branch staff. Provisions for expansion of the office room by attaching the existing computer room into office room by converting one of the existing store rooms into dining room, dismantling the existing asbestos sheet of the computer room and storeroom, constructing a new toilet attached to the Joint Director's room, providing sheet roof for the newly constructed area, tile work, painting and all other necessary items for the satisfactory completion of the work etc., were given. Agreement of the above work was executed on 18/05/2019. The work has been completed satisfactorily on 23/10/2019.

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 conducts studies to compute the present capacity of reservoirs and other water bodies. Such studies are conducted using modern electronic method called 'Integrated Bathymetric System' (IBS).In order to ascertain the underwater profile of the sediment layer a modern sophisticated instrument called 'Sub Bottom Profiler' is used. From 2004 onwards, KERI has completed 44 studies using IBS studies which include Mullaperiyar, Vembanad Lake and Kattampally Wetland. Sub Bottom profiler was used for16of the above studies,

KERI constituted a team consisting

THE SURVEY TEAM

Director	Er.C.A.Jamaludheen Er. Mini Raju Sebastian, Er. Alice Thomas
Joint Director	Er.R.Rema

Team Leader	Er.Shini K.K, Deputy Director
Technical Team	
Er.Roshni S S	Assistant Director
Er. Dhanya K S	Assistant Director
Er.Francy V Antony	Assistant Director & Research Assistant
Devidath S Punnakkal	Research Assistant
Saju Davis	Second Grade Overseer
Divyesh V B	Third Grade Overseer
Jayakumar T.R	Boat Driver(on HR Basis)

C.1.1 Equipments used

C.1.1.1SUB 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 Fig 1 & 2.

Fig.1 Top- side Unit

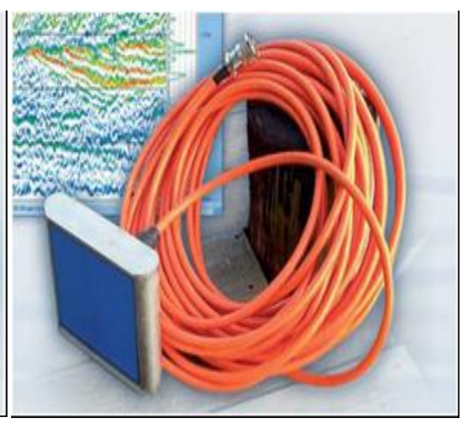


Fig.2 Transducer

C.1.1.2DGPS SIMRAD MX-610

DGPS MX- 610 (refer Plate 1) is highly reliable and it receives correction from a permanent reference station, which is approved by Government of India, Department of Light house and

Light ship. It can also track up to 12 satellites to achieve maximum positional accuracy. The received position is transferred to Echo Sounder.

Fig.3MX610 Navigation System

C.1.1.3MIDAS Surveyor - Echo-sounder

The MIDAS Surveyor is a revolution of small boat survey work with an integral GPS receiver (plate 2). It logs and displays DGPS position data in WGS 84 or Local Grid. This Echo-sounder is designed to measure under water depth up to 1200m. Accuracy of instrument is 1centimeter. A dual frequency echo-sounder is specified to distinguish between fluff top depth and the consolidated bottom. The high frequency (200 KHz) is used to detect the top of the mud/sediment. Under favorable conditions the low frequency signal (33 KHz) can penetrate into the bottom and reveal information about the bottom structure.

Fig.4 MIDAS Surveyor Echo Sounder

C.1.1.4FRP Boat (mobile station)

A Fibre Reinforced Plastic (FRP) boat with two 60 HP petrol out board engines is used as the Survey Boat. The boat has dimension of 7.5mX 2.66mX 1.20m and 8 persons capacity with the equipment. The boat with all the survey equipment is referred as the ‘mobile station’. For the power supply, two solar panels of 80Watt each are mounted on the roof of the boat.

Fig.5 FRP Boat

Mobile station set up for data collection is shown in fig.6

Fig.6 Equipment Set up inside the Boat

Software

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

C.1.2 DATA COLLECTION

The mobile station consists of the DGPS and its antenna, Echo sounder, Sub Bottom Profiler and the transducers, etc., is mounted on the FRP boat. The transducer of Sub Bottom Profiler is permanently fixed at the center of the boat. The traducer of Echo sounder is connected to the left side of the boat and is detachable. Proper connections are made between these equipment and the laptops for the data collection. The boat is sailed along the planned track with a speed of 3 to 4 knots. The data from the Echo sounder and Sub Bottom Profiler is collected simultaneously through two laptops as shown in fig.7. For IBS Survey, the laptop loaded with QINSY survey software is used; There are three modules in the Qinsy Software. Data Acquisition, Data Processing and Data export/import.

Fig.7 Data Collection set up inside the Boat

The system**SES-2000**(Sediment Echo Sounder)Sub Bottom Profiler is a 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 10m 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 15 kHz. 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 50 pings 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.

C.2 WORKS CARRIED OUT DURING 2018-19

The sedimentation study of Peechi, Chimmoni, Walayar, Kuttiyadi and Boothathakettu Barrage were conducted during the FY 2018-19. During the preparation of the previous annual report, the reports of the above works are under preparation. The reports are included now.

C.2.1 SEDIMENTATION STUDY OF PEECHI RESERVOIR USING INTEGRATED BATHYMETRIC SYSTEM (IBS) & SUB BOTTOM PROFILER (REPEAT STUDY)

Results And Discussion

C.2.1.1 ESTIMATION OF CAPACITY

The survey is carried out at the water level of 78.6m. The original water holding capacity at this level is 103.035 Mm^3. As per the current IBS study the volume at the same level is estimated as 90.122Mm^3 and the corresponding water spread area is 9.6Sq.km. Total capacity reduction of the reservoir at this level is 12.913Mm^3 in 62 years, i.e., the reduction in capacity at the specified level is 12.53%. In the sedimentation survey conducted in year 2013, the estimated capacity was 86.186$Mm^3$and the corresponding water spread area was 10.69Sq.km. There is an increase in capacity of the reservoir from the year 2013 to 2018 and this is due to the heavy flood occurred in the year 2018. This is detailed in the next chapter.

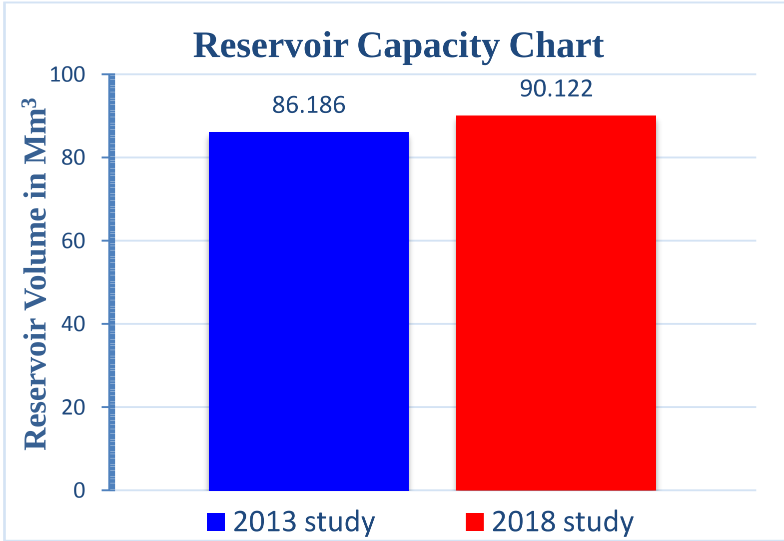


Fig1.1 Increase in Reservoir capacity

Table 1.1 Capacity of the reservoir at WL 78.6m

Year of Study	Capacity In Mm^3	Reduction in Capacity w.r.t Original Volume (103.035 Mm^3)	
		In Mm^3	In Percentage
2013	86.186	16.849	16.4
2018	90.122	12.913	12.5

Table.1.1 shows the comparison in capacity of the reservoir at the water level of 78.6m between the two consecutive studies conducted in 2013& 2018. The contour map of water spread area is shown in Fig. 1.2.

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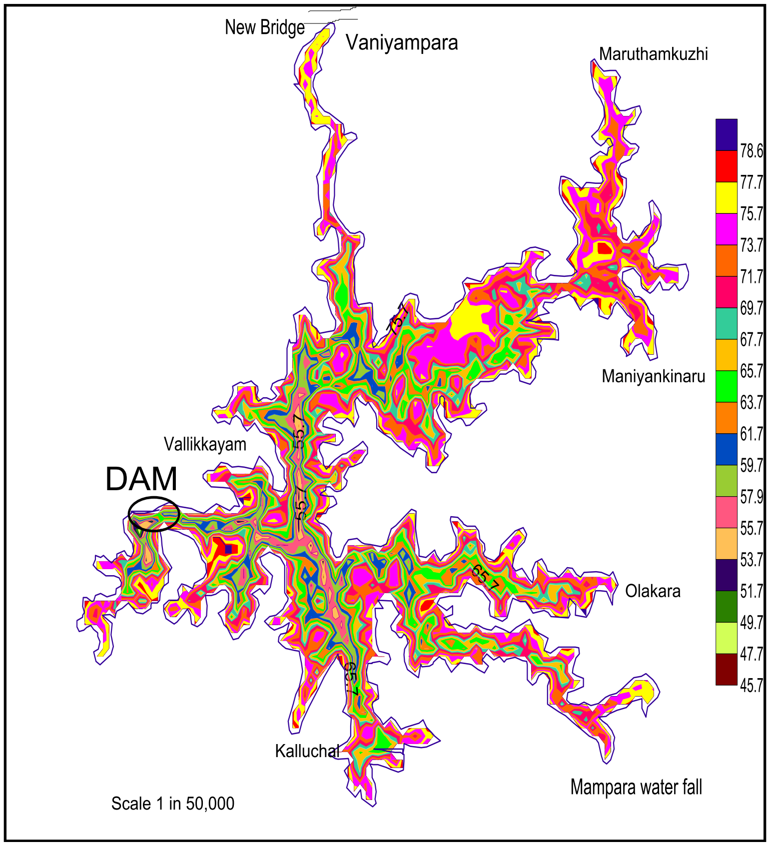


Fig 1.2. Contour Map based on IBS Survey

C.2.1.2 CAPACITY AT DIFFERENT WATER LEVEL

Reservoir volume at different water levels can be found out using the IBS data in Surfer software. The capacity reduction obtained from the IBS is comparable with the sediment volume calculated from the Sub Bottom Profiler. The present capacity at different level is compared with the original and IBS result in 2009 and is shown in Table.1.2

Table 1. 2 Reservoir Capacity at different water levels

Sl. No.	Water Level	Water Holding Capacity		
		Original	IBS Survey 2013	IBS Survey 2018
	(m)	(M. Cub. m)	(M. Cub. m)	(M. Cub m)
1	78.6	103.035	86.186	90.122

2	77.7	92.5	74.427	79.677
3	75.7	71.6	52.809	59.26
4	73.7	47.2	38.03	43.529
5	71.7	37.674	27.189	31.28
6	69.7	28.596	18.932	21.722
7	67.7	21.989	12.794	14.57
8	65.7	18.106	8.406	9.161
9	63.7	15.943	5.34	5.323
10	61.7	12.463	3.271	2.805
11	59.7	11.375	2.037	1.259
12	57.7	6.219	1.271	0.41
13	55.7	3.951	0.936	0.078
14	53.7	2.535	0.741	0.019
15	* 53.34	2.28	0.714	0.015
16	51.7	1.08	0.597	0.0041
17	49.7	0.81	0.484	0.00009
18	47.7	0.686	0.392	0
19	45.7	0.414	0.317	0

***Dead Storage Level**

The original storage capacity curve is compared with the same obtained from the IBS surveys in 2013 and 2018 as shown in Fig.1.3

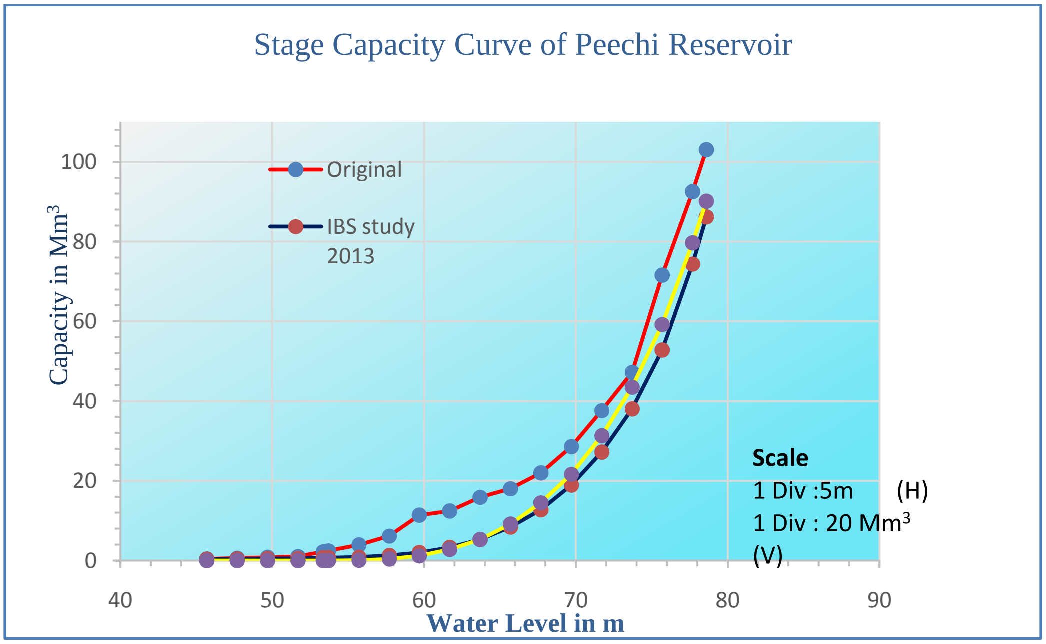


Fig.1.3 Water level v/s Water holding capacity curve

C.2.1.3 WATER SPREAD AREA AT DIFFERENT WATER LEVEL

The present water spread area at different level is compared with IBS result in 2013 and is shown in Table.1.3. Fig.1.4 shows its graphical representation.

Table1.3 Water spread area at different water levels.

Sl. No.	Water Level	Water Spread Area	
		IBS Survey 2013	IBS Survey 2018
	(m)	(M. Cub. m)	(M. Cub m)
1	78.6	10.69	9.6
2	77.7	10.28	9.33
3	75.7	7.94	8.022
4	73.7	5.95	6.49
5	71.7	4.62	5.2
6	69.7	3.55	4.03
7	67.7	2.6	3.09

8	65.7	1.85	2.29
9	63.7	1.28	1.56
10	61.7	0.84	0.99
11	59.7	0.39	0.57
12	57.7	0.25	0.28
13	55.7	0.13	0.066
14	53.7	0.09	0.012
15	* 53.34	0.08	0.009
16	51.7	0.07	0.004
17	49.7	0.06	0.005
18	47.7	0.05	0
19	45.7	0.04	0

*** Dead Storage Level**

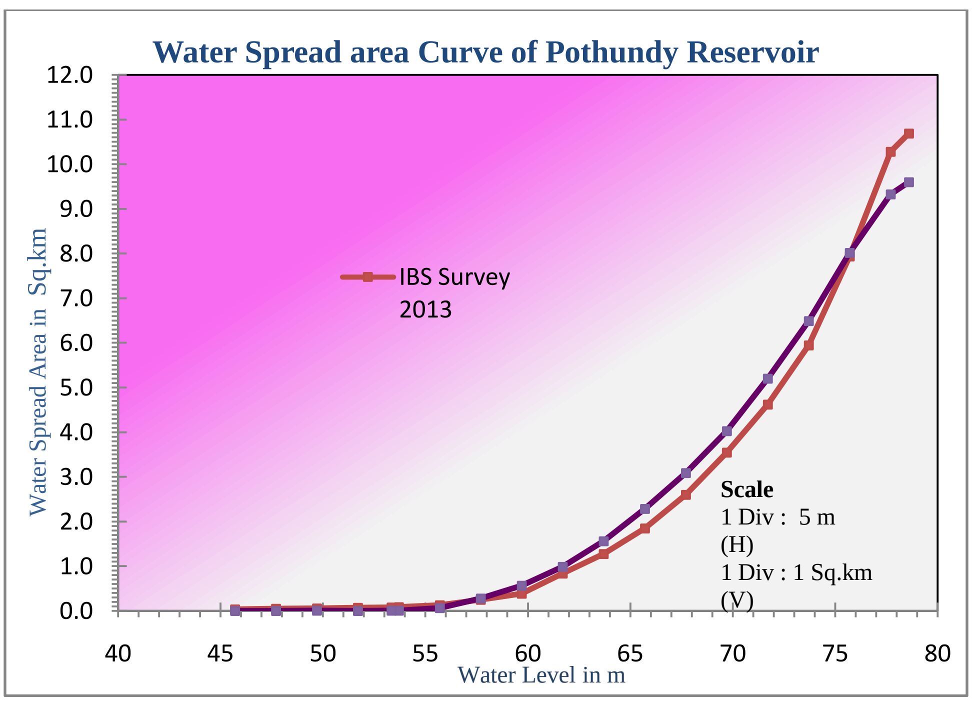


Fig.1.4 Water level v/s Water spread area curve

DISCUSSION

The FRL of Peechi Reservoir was 79.25m at the time of commissioning and the reservoir capacity corresponding to this level was 110.436Mm^3. Later the Dam Safety Authority had revised this and brought down the safe FRL to 78.6m in the year 2007.

Sedimentation survey of the reservoir had been carried out in 1995, 2005, 2013 and 2018. The details of the survey and the results are as shown in the table below.

Table1. 4 IBS Study Details

Year	FRL meters	Corresponding Reservoir Capacity in Mm^3	Method of Sedimentation Survey	Remarks
1957	79.25	110.436	Contour Survey during investigation	
1995	79.25	79.611	Manual survey using sounding rods	
2005	78.6	87.055	IBS	Sounding interval was 4m
2013	78.6	86.184	IBS	Sounding interval was 2m
2018	78.6	90.122	IBS	Sounding interval was 2m
2018	78.6	91.04	Sub bottom Profiler	Continuous Data

After the flood in 2018, the total reservoir capacity determined using IBS is 90.122Mm^{3}at the water level of 78.6m.

In general it has been observed worldwide that the reservoir capacity decreases with time. The life of reservoirs is determined by it's trap efficiency. The sedimentation in reservoirs is dependent on many factors such as the size of the reservoir relative to the volume of sediment flowing in which in turn depends on river discharge, sediment load carried by the stream, topographical and physical features of the catchment area, duration of rainy season etc.

Considering the accuracy of methodology adopted, the survey conducted in 2013 can be taken to determine the average rate of sedimentation. From 1957 to 2013, the reservoir volume had decreased from $103.035Mm^3$ to $86.184Mm^3$ in 56 years. Therefore the average rate of sedimentation can be considered as $0.29Mm^3$/year. This is comparable to the average value of 0.2 percent in USA.

At the prevailing rate, the reservoir capacity should have been reduced to $84.734Mm^3$in the year 2018. But the reservoir capacity has increased to $90.122Mm^3$. Between 2013 and 2018 the reservoir capacity has increased by $3.938Mm^3$. This extraordinary phenomenon requires a valid explanation.

For the purpose the sedimentation survey results for the dam were analysed and the following observations have been made.

- ***From water levels of 78.60m to 65.70m the reservoir capacity shows an increase.***
- ***Since the depth remains constant there has to be an increase in the water spread area of the reservoir.***
- ***Up to reservoir level of 77.70m there is decrease in the water spread area and there after an increase in water spread area is observed up to level 57.70.***
- ***From reservoir level of 57.70 m the water spread area has decreased.***
- ***From reservoir level of 65.70m, up to bed level 45.70m, the reservoir capacity has reduced.***

The above observations need to be explained. It is a well-known fact that the triggering causes of land slides are heavy rain fall and earth quake. In Kerala’s landslide prone area map, all districts except Alappuzha are marked as land slide prone areas.

- ***During the initial phases of the 2018 flood, large quantity of sediments from surface run-off along the catchment area might have got deposited on the upper reaches of the reservoir. It has to be clearly understood that in normal years, the water level is always below 77.50m and the slope above this level will be much more stable than that below this level.***

- ***Accumulation of the sediment load might have disturbed the equilibrium of the weak reservoir slopes from 77.7m. Due to this, the slipped mass would have slid down suddenly or in a creeping motion from 77.7m to 57.70m increasing the water spread area in this 20m stretch. (This fact is evidenced from the photographs of the reservoir slopes attached with the report.)-plate 1 & plate 2.***

Plate-1 Soil erosion

Plate-2. Soil erosion

- ***Major part of the sediment load from the heavy floods must have been carried away due to the high inflow rate and velocity during the extra ordinary flood of 2018.***

- ***Hence, the net volume of sediment trapped from the inflow and land slide inside the reservoir, was less than the volume of soil mass lost by land slide. This led to an increase in the capacity of the reservoir.***

The storage capacity between two consecutive levels from the WL 78.6m to 45.7m were compared for the surveys in 2013 and 2018 and it is shown in Fig. 1.5.

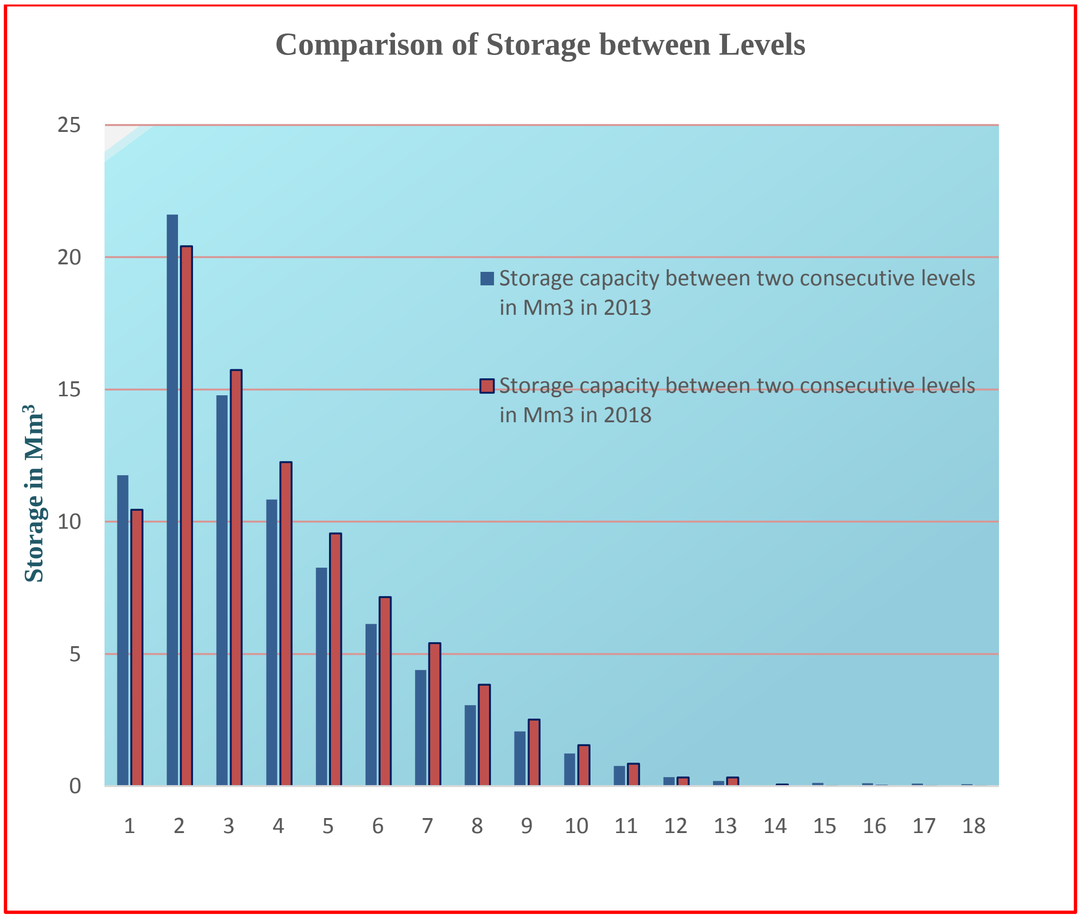


Fig.1.5 Bar chart showing reservoir storage between consecutive water levels

By analysing the storage capacity between the levels from the two studies, it is clear that they follows the same pattern in the variation of the storage capacity between the two cosecutive levels. It is explained in the following fig.1.6.

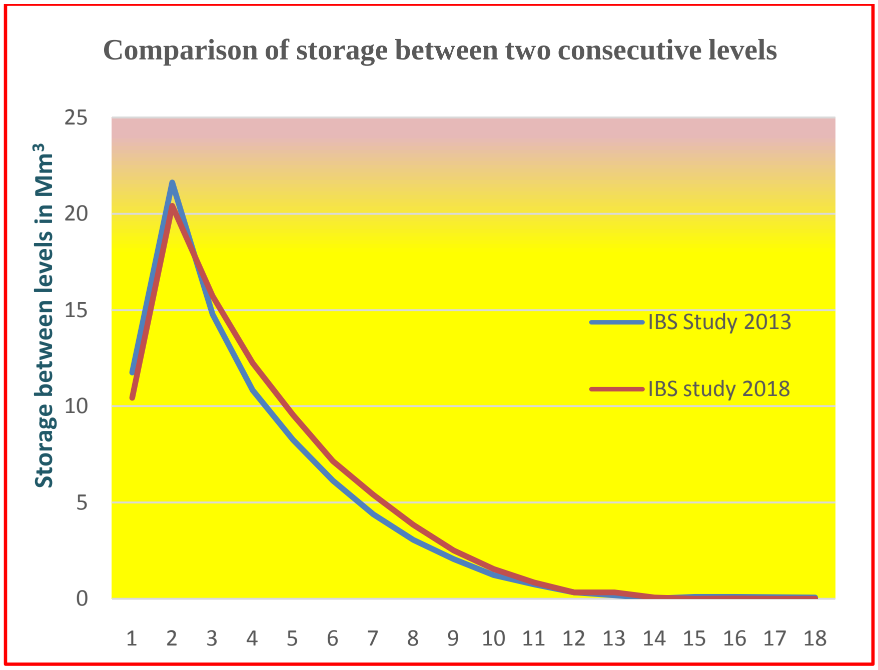


Fig 1.6 Comparison of reservoir storage between consecutive water levels

C.2.2 SEDIMENTATION STUDY OF CHIMMONI RESERVOIR USING INTEGRATED BATHYMETRIC SYSTEM (IBS) & SUB BOTTOM PROFILER

Results And Discussion

C.2.2.1 ESTIMATION OF CAPACITY

The survey is carried out at the water level of 75.76m. The original water holding capacity at this level is 146.57Mm^3. As per the current IBS study the volume at the same level is estimated as 145.44Mm^{3}and the corresponding water spread area is 8.63Sq.km.Total capacity reduction of the reservoir is 1.13Mm^{3}in 22 year, i.e. the reduction in capacity at the specified level is 0.77%. The capacity reduction is due to the sediment deposit.

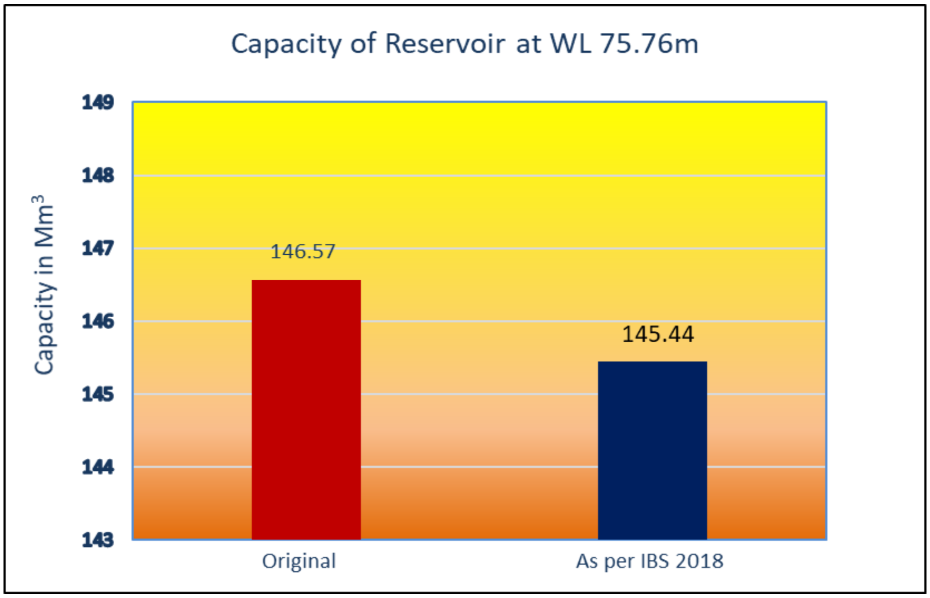


Fig 2.1 Comparison of Reservoir Capacity at Water Level 75.76m

Table 2.1 Capacity of the reservoir at WL 78.6m

Year of Study	Water Level (m)	Capacity In Mm^3	Reduction in Capacity w.r.t Original Volume (146.57Mm^3)	
			In Mm^3	In Percentage
2018	75.76	145.44	1.13	0.77

The contour map of water spread area is shown in Fig 2.2. at an interval of 2 m.

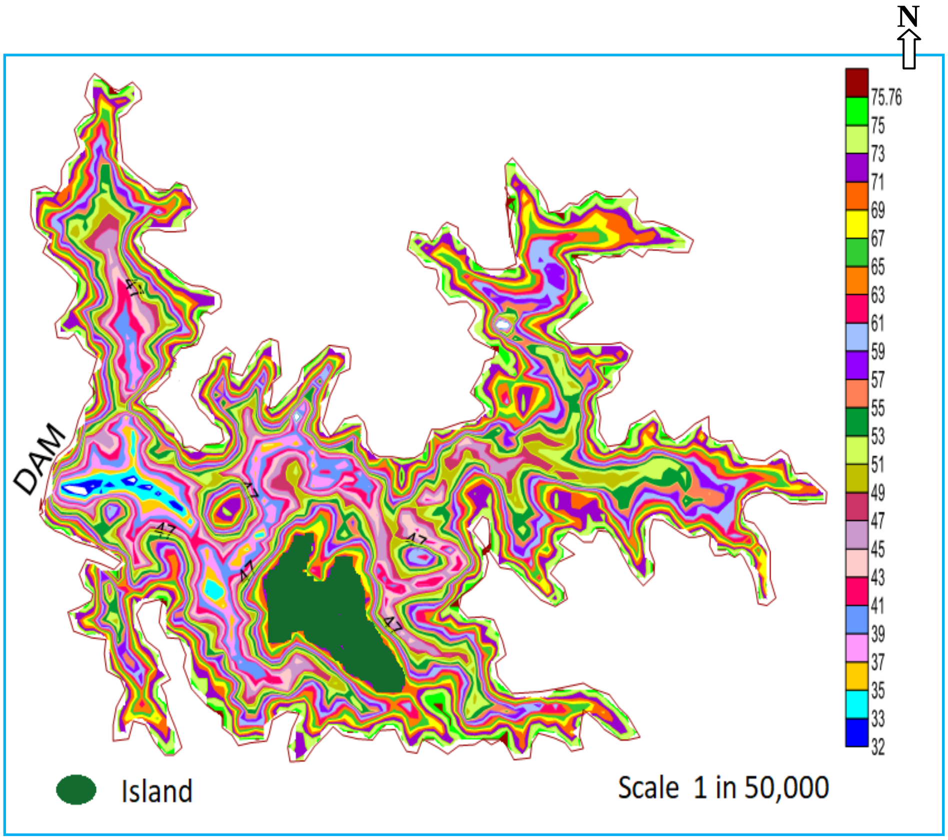


Fig 2.2 Contour map of Chimmoni Reservoir based on IBS survey

C.2.2.2 CAPACITY AT DIFFERENT WATER LEVEL

Reservoir volume at different water levels can be found out using the IBS data in Surfer software. The capacity reduction obtained from the IBS is comparable with the sediment volume calculated from the Sub Bottom Profiler. The present capacity at different level is compared with the original and is shown in Table 2.2.

Table 2.2 Reservoir capacity at different water levels.

Sl. No.	Water Level	Water Holding Capacity		Percentage Reduction in Capacity
		Original	IBS Survey 2018	
	(m)	(M. Cub. m)	(M. Cub m)	%
1	75.76	146.57	145.44	0.77
2	74	133	129.66	2.51
3	73	125	121.28	2.98

4	72	120.001	113.39	5.51
5	71	112.5	106.08	5.71
6	70	105	99.21	5.51
7	69	98.6	92.66	6.02
8	68	92.5	86.4	6.59
9	67	87.25	80.41	7.84
10	66	82	74.66	8.95
11	65	76.5	69.14	9.62
12	64	70.5	63.84	9.45
13	63	65.6	58.77	10.41
14	62	60.9	53.92	11.46
15	61	55.75	49.3	11.57
16	60	50.75	44.9	11.53
17	59	47	40.74	13.32
18	58	43	36.81	14.40
19	57	39.25	33.11	15.64
20	56	35.6	29.64	16.74
21	55	32	26.4	17.50
22	54	29	23.38	19.38
23	53	25.5	20.59	19.25
24	52	22.5	18.02	19.91
25	51	19.8	15.68	20.81
26	50	17.5	13.55	22.57
27	49	15.5	11.62	25.03
28	48	13.5	9.89	26.74
29	47	11.6	8.35	28.02
30	46	10	6.98	30.20
31	45	8.35	5.76	31.02
32	44	7	4.69	33.00
33	43	5.75	3.75	34.78
34	42	4.625	2.94	36.43
35	41	3.85	2.25	41.56
36	40*	2.85	1.68	41.05

***Dead Storage Level**

The original storage capacity curve is compared with IBS survey in 2018 as shown in Fig.2.3.

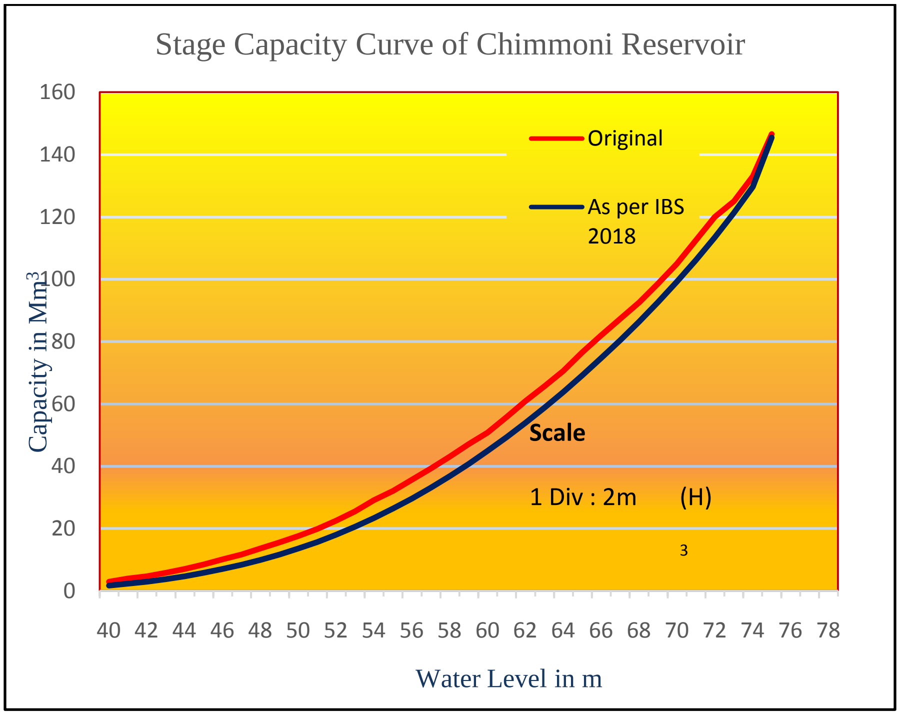


Fig.2.3. Capacity curve (Water level V/s Capacity)

C.2.2.3 WATER SPREAD AREA AT DIFFERENT WATER LEVEL

The present water spread area at different level is compared with the original and is shown in Table 6.3. Fig.6.4 shows its graphical representation

Table 2.3 Water spread area at different water levels.

Sl. No.	Water Level	Water Spread Area	
		Original	IBS Survey 2018
	(m)	(Sq. Km)	(Sq. Km)
1	75.76	8.516	8.63
2	74	7.95	8.29
3	73	7.675	8
4	72	7.4	7.54
5	71	7.15	7.04
6	70	6.9	6.71
7	69	6.65	6.42
8	68	6.425	6.16
9	67	6.2	5.91

10	66	5.975	5.68
11	65	5.725	5.46
12	64	5.5	5.24
13	63	5.25	5.01
14	62	5	4.78
15	61	4.75	4.56
16	60	4.5	4.33
17	59	4.275	4.09
18	58	4.05	3.86
19	57	3.85	3.62
20	56	3.6	3.39
21	55	3.35	3.17
22	54	3.15	2.94
23	53	2.9	2.71
24	52	2.7	2.48
25	51	2.5	2.27
26	50	2.25	2.05
27	49	2.075	1.84
28	48	1.9	1.65
29	47	1.75	1.48
30	46	1.6	1.31
31	45	1.45	1.15
32	44	1.3	1.01
33	43	1.15	0.88
34	42	1.05	0.76
35	41	0.9	0.64
36	40	0.8	0.52

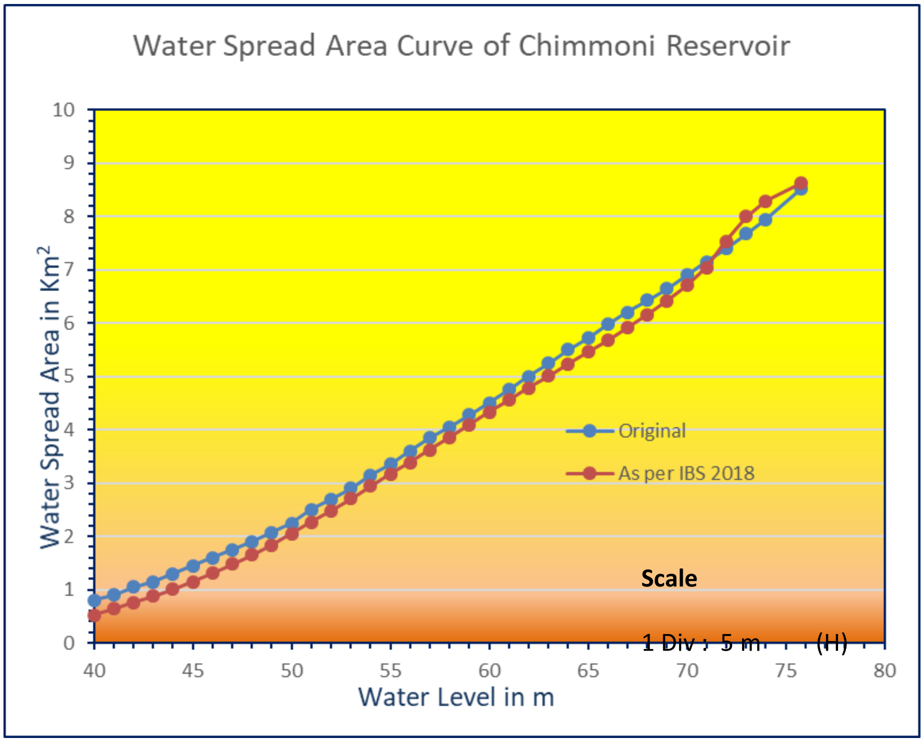
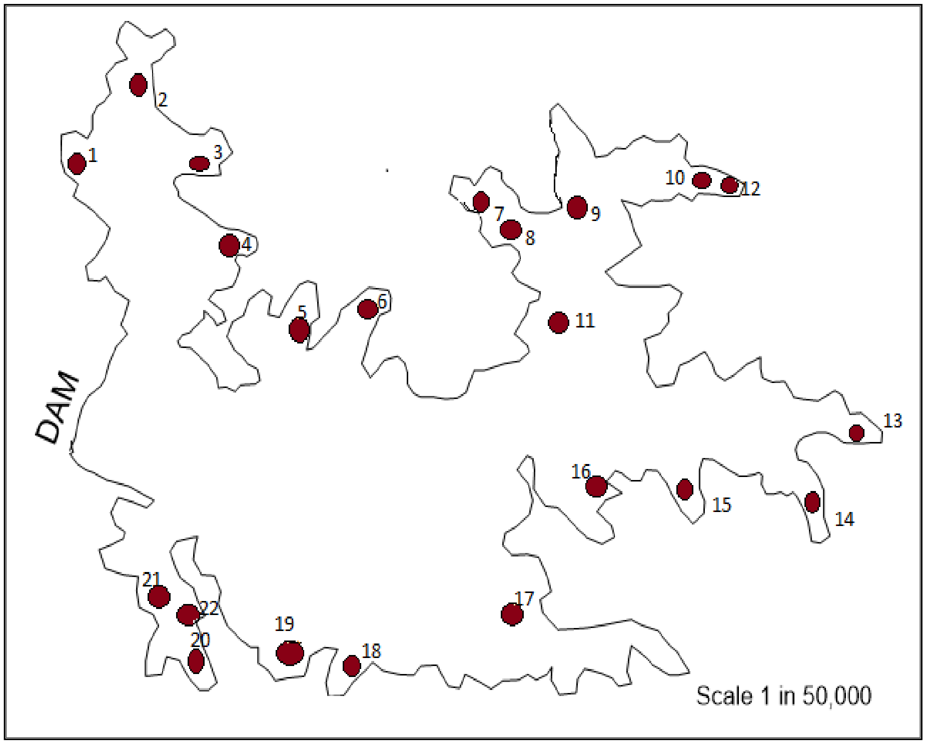


Fig.2.4 Water level v/s water spread area curve

7.0 ANALYSIS OF SOIL SAMPLE



Location of Soil Samples

The soil samples were analyzed and result is shown in table 2.4. The average percentage of clay, silt, sand and gravel of the analyzed samples are graphically represented in Fig 2.5 Since we are analyzing the grab samples the percentages of soil particles are only indicative and not accurate. For accurate assessment of contents in the soil, core sample analysis must be done.

Table 2.4 Soil Sample Analysis Result

Sl No	Sample Position	Depth of Sample Taken in m	Nature of Sample	Soil Texture	Colour	Specific Gravity	% of various size of soil particles			
							Clay	Silt	Sand	Gravel
1	N- 1155818 E-659844	8.5	Disturbed	Silty Sand	Lead grey	2.32	4	40	56	0
2	N- 1156448 E-660283	10.7	Disturbed	Silty Sand	Lead grey	2.12	6	58	36	0

3	N-1155875 E-660639	14.8	Disturbed	Silty Sand	Lead grey	2.01	10	81	9	0
4	N-1155393 E-660908	10.5	Disturbed	Silty Sand	Lead grey	1.99	8	76	16	0
5	N-1154866 E-661352	13	Disturbed	Silty Sand	Lead grey	2.51	5	21	74	0
6	N-1155004 E-661933	10.5	Disturbed	Sandy Soil	Dark Blue grey	2.43	4	32	62	2
7	N-1155781 E-662418	7.3	Disturbed	Sandy Soil	Dark Blue grey	2.51	3	12	85	0
8	N-1155536 E-662792	13.4	Disturbed	Silty Soil	Lead grey	2.07	8	54	38	0
9	N-1115565 E-663262	17.6	Disturbed	Silty Sand	Lead grey	2.2	6	38	56	0
10	N-1155729 E-664275	6.5	Disturbed	Silty Sand	Lead grey	1.97	6	25	69	0
11	N-1155064 E-663266	15	Disturbed	Silty Sand	Lead grey	2.26	5	38	57	0
12	N-1155499 E-664042	10	Disturbed	Silty Sand	Lead grey	2.25	4	29	67	0
13	N-1154280 E-665156	6.8	Disturbed	Silty Sand	Lead grey	`2.16	4	41	55	0
14	N-1153992 E-664756	13.5	Disturbed	Silty Sand	Lead grey	2.1	3	43	54	0
15	N-1153853 E-663205	10	Disturbed	Silty Sand	Lead grey	2.21	4	38	58	0
16	N-1153045 E-663539	12.5	Disturbed	Silty Soil	Lead grey	1.84	4	57	39	0
17	N-1153235	14.2	Disturbed	Silty	Lead	2.22	5	46	49	0

	E-662678			Sand	grey					
18	N-1152857 E-661819	11.4	Disturbed	Sandy Soil	Lead grey	2.3	4	20	76	0
19	N-1152928 E-661330	14.5	Disturbed	Silty Sand	Lead grey	2.35	3	25	72	0
20	N-1152928 E-660691	7.8	Disturbed	Silty Sand	Lead grey	2.31	4	16	80	0
21	N-1153384 E-660499	10.5	Disturbed	Silty Sand	Light Brown	2.18	9	37	54	0
22	N-1153189 E-660693	5.7	Disturbed	Silty Sand	Light Brown	2.05	12	37	51	0

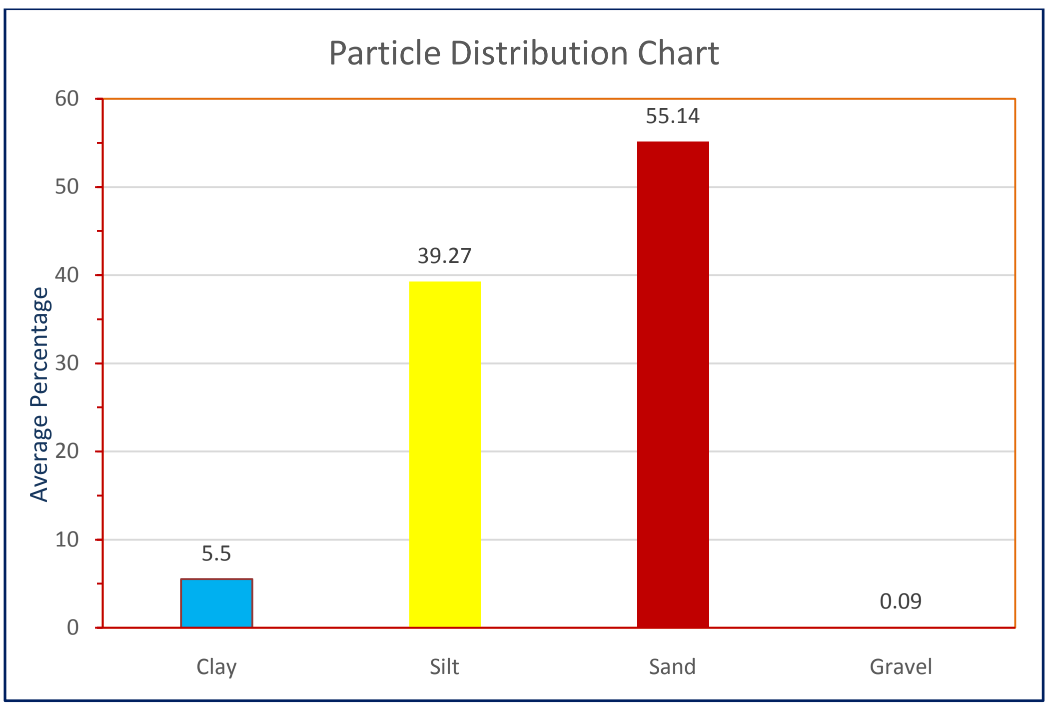


Fig 2.5 Soil particle distribution of the disturbed samples

DISCUSSION

The original Capacity of Chimmoni Reservoir at 75.76 m level is 146.57 $Mm^{3.}$

- ***As per the present study, the Reservoir capacity is 145.44 Mm^3at the water level of 75.76m and the capacity is reduced by 1.13 Mm^3 in 22 years @ 0.051 Mm^3/per year.***

- ***The rate of capacity reduction is .03 %. This is very low comparing with the rates of other reservoirs. This may be due to the washout of sediments through the spillway during the heavy flood occurred in 2018.***

- ***The average thickness of the sediment deposit is 0.131m in 22 years, the rate of deposition 0.59cm/Year.***

- ***Volume at dead storage level is 1.68Mm^3, Percentage reduction in dead storage is 41.05 % in 22 years.***

- ***Sediment layer profile of the reservoir area at an interval of 100m is obtained from the Sub Bottom Profiler.***

The graphical representation of reduction in volume is shown in Fig.2.6

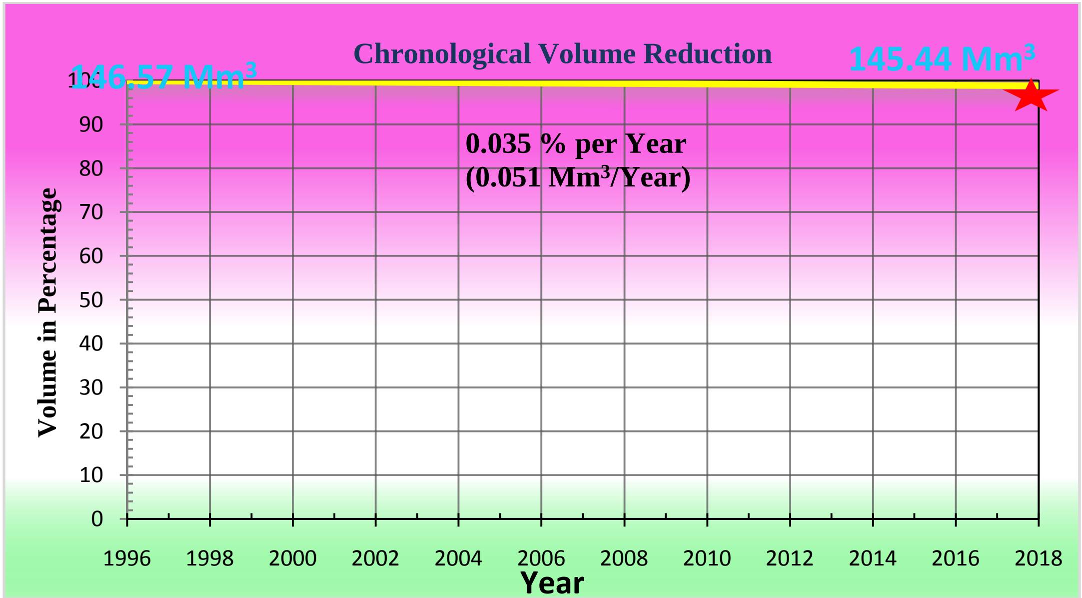


Fig 2.6 Chronological Volume Reduction

C.2.3 SEDIMENTATION STUDY OF WALAYAR RESERVOIR USING INTEGRATED BATHYMETRIC SYSTEM (IBS) & SUB BOTTOM PROFILER (REPEAT STUDY)

Results And Discussion

C.2.3.1 ESTIMATION OF CAPACITY

The survey is carried out at the water level of 200.66m. The original water holding capacity at this level is 12.762 Mm^3. As per the current IBS study the volume at the same level is estimated as 10.65Mm^3 and the corresponding water spread area is 1.73Sq.km.Total capacity reduction of the reservoir at this level is 2.112Mm^3 in 62 years, i.e., the reduction in capacity at the specified level is 16.55%. The capacity reduction is due to the sediment deposit.

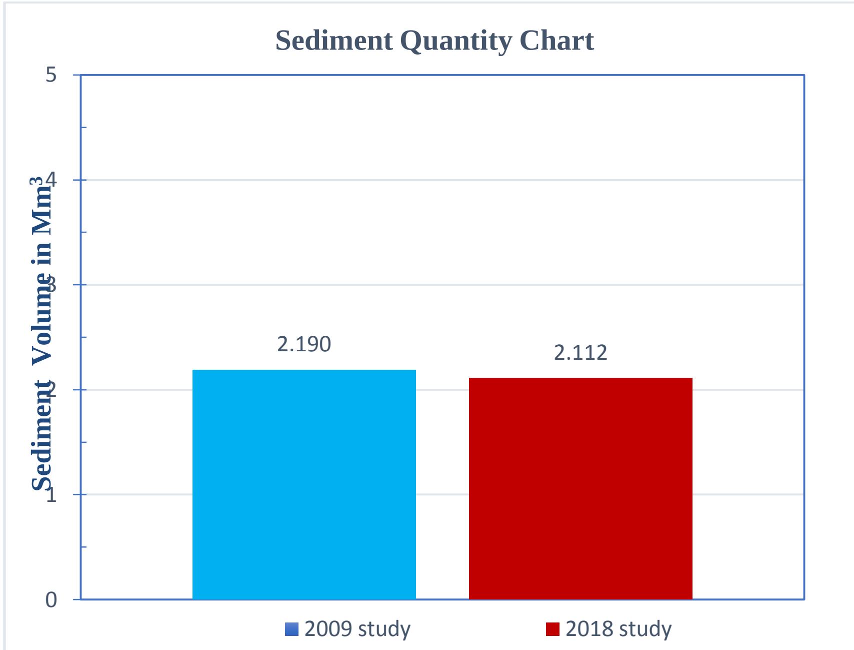


Fig.3.1 Variation in Sediment quantity

Table 3.1 Capacity reduction of the reservoir at WL 200.66m

Year of Study	Capacity	Reduction in Capacity w.r.t. Original Volume (12.762 Mm^3)	
		In Mm^3	In Percentage
2009	10.572	2.19	17.16
2018	10.650	2.112	16.55

Table 3.1 shows the comparison of reservoir capacity at the water level of 200.66m between the two consecutive studies conducted in 2009 & 2018.The contour map of water spread area is shown in Fig 3.2.

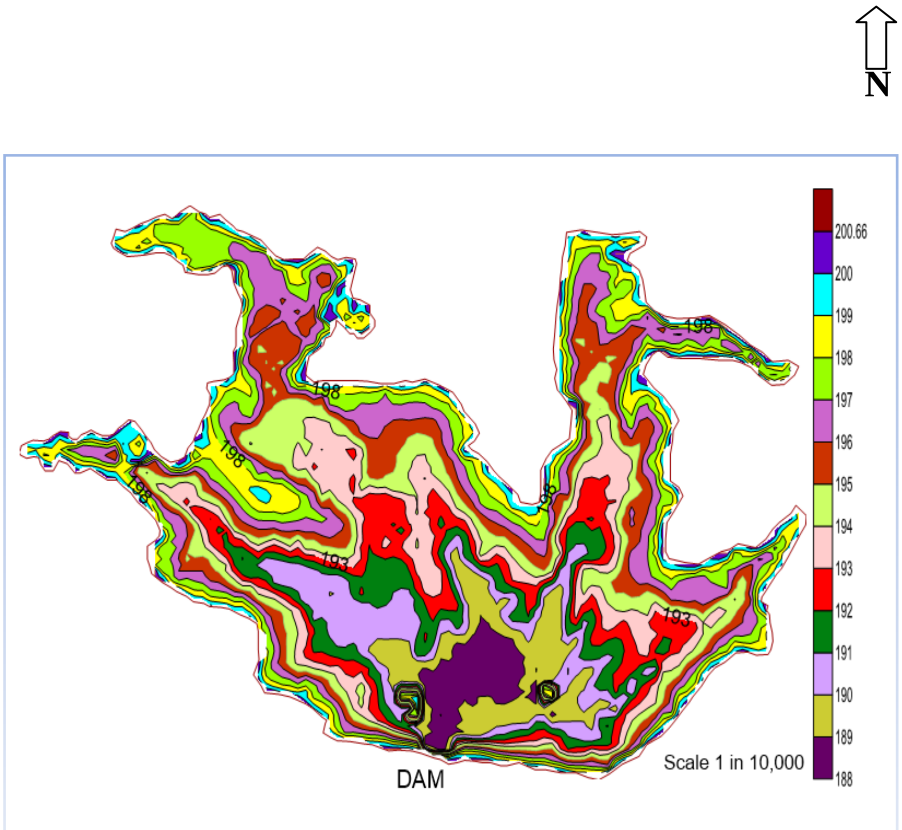


Fig 3.2 Contour Map based on IBS Survey

C.2.3.2 CAPACITY AT DIFFERENT WATER LEVEL

Reservoir volume at different water levels can be found out using the IBS data in Surfer software. The capacity reduction obtained from the IBS is comparable with the sediment volume calculated from the Sub Bottom Profiler. The present capacity at different level is compared with the original and IBS result in 2009 and is shown in Table 3.2.

Table 3.2 Reservoir capacity at different water levels.

		Water Holding Capacity	Percentage

Sl. No.	Water Level	Original	IBS Survey 2009	IBS Survey 2018	Reduction in Capacity (IBS 2018)
	m	M. Cub. m	M. Cub. m	M. Cub m	%
1	200.66	12.762	10.572	10.65	16.55
2	200	11.428	9.212	9.46	17.22
3	199	9.478	7.359	7.738	18.36
4	198	7.55	5.758	6.159	18.42
5	197	6.311	4.394	4.759	24.59
6	196	5.055	3.25	3.564	29.50
7	195	3.843	2.322	2.582	32.81
8	194*	3.212	1.582	1.78	44.58
9	193	2.589	1.018	1.15	55.58
10	192	1.952	0.603	0.68	65.16
11	191	1.581	0.299	0.341	78.43
12	190	1.331	0.103	0.122	90.83
13	189	0.827	0.0057	0.008	99.03
14	188	0.627	0	0	100.00

***Dead Storage Level**

The original storage capacity curve is compared with the same obtained from the IBS surveys in 2009 and 2018 as shown in Fig.3.3.

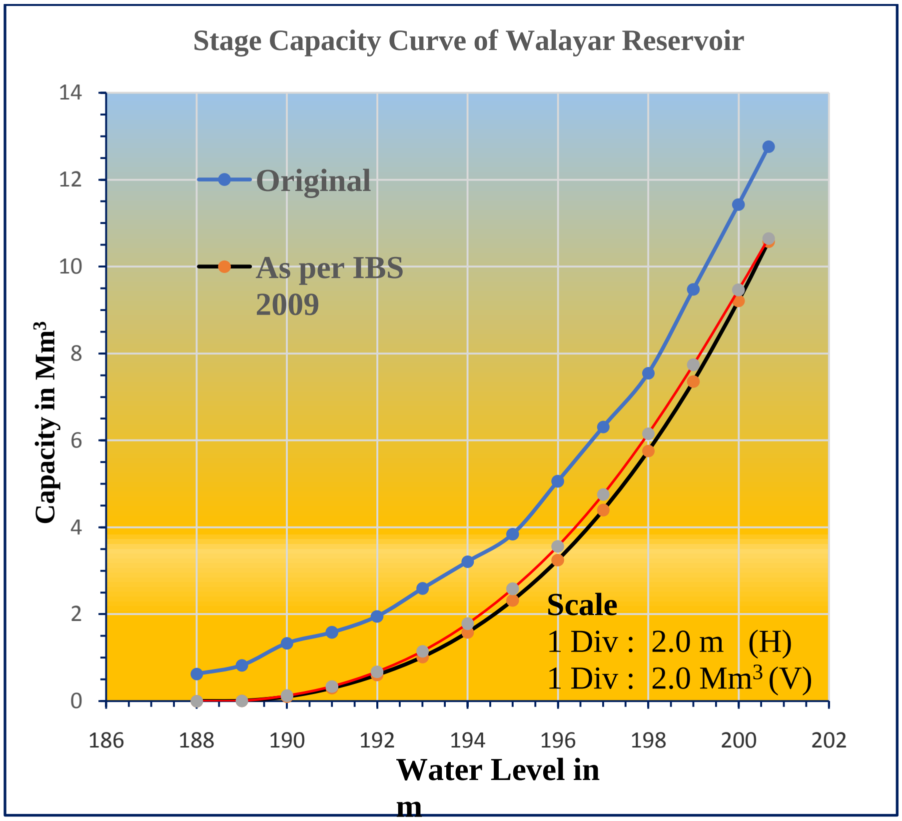


Fig.3.3 Water level v/s water holding capacity curve

C.2.3.3 WATER SPREAD AREA AT DIFFERENT WATER LEVEL

The present water spread area at different level is compared with the original and IBS result in 2009 and is shown in Table 3.3. Fig.3.4 shows its graphical representation.

Table 3.3 Water spread area at different water levels.

Sl. No.	Water Level	Water Spread Area	
		IBS Survey 2009	IBS Survey 2018
	m	Sq.km	Sq.km
1	200.66	2.08	1.73
2	200	1.93	1.71
3	199	1.72	1.64

4	198	1.47	1.490
5	197	1.26	1.300
6	196	1.03	1.090
7	195	0.83	0.890
8	194	0.65	0.720
9	193	0.48	0.540
10	192	0.35	0.400
11	191	0.25	0.280
12	190	0.14	0.160
13	189	0.05	0.060
14	188	0	0.000

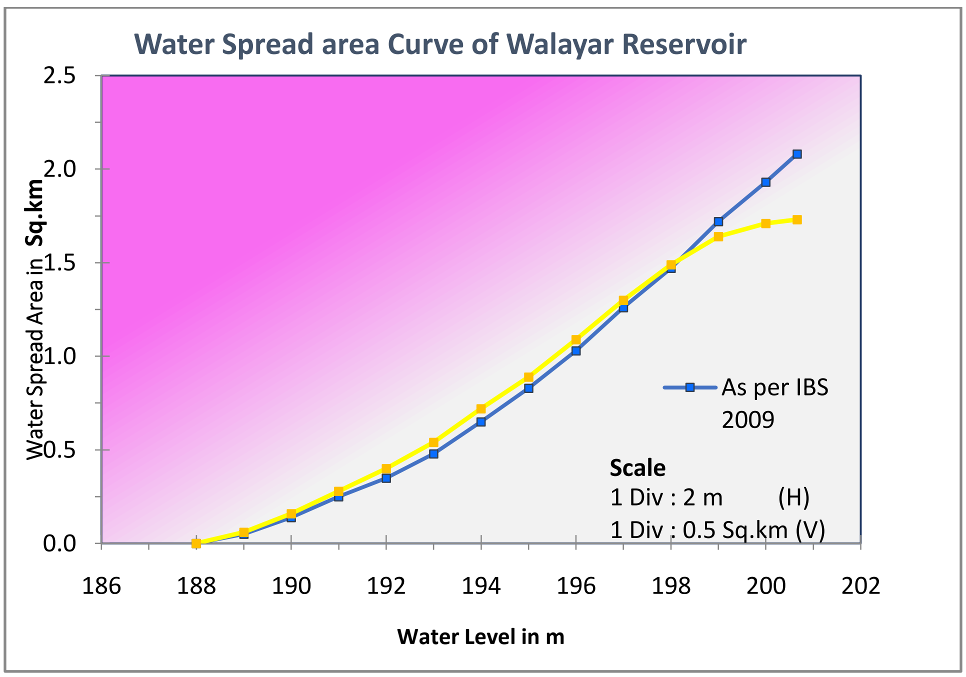


Fig.3.4 Water level v/s water spread area curve

7.0 ANALYSIS OF SOIL SAMPLE

N

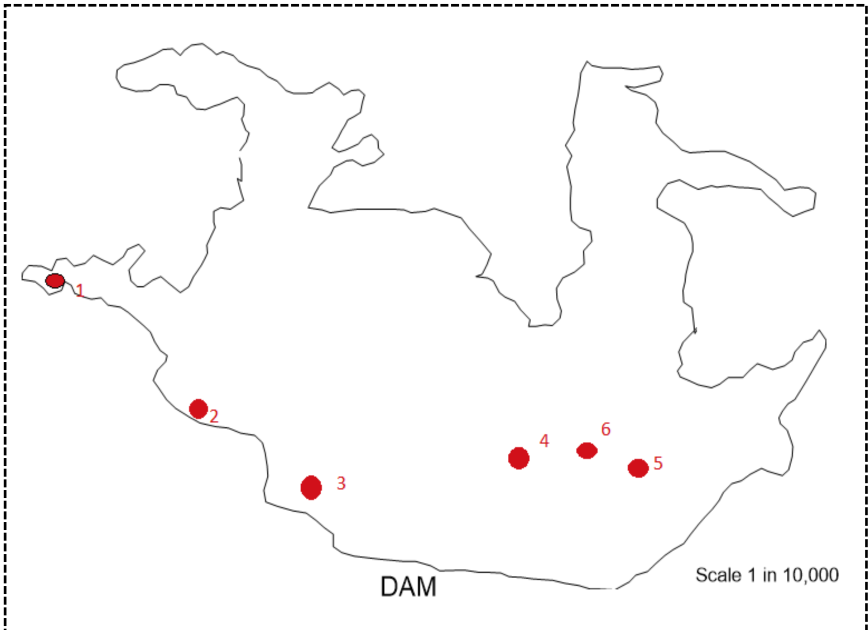


Fig.3.5 Location of Soil Samples

The soil samples were analyzed, and result is shown in Table 3.4. Six samples were analyzed in the sedimentation study conducted in 2009. The average percentage of clay, silt, sand and gravel of the analyzed samples in the present and previous studies are graphically represented in Fig 3.6. Since we are analyzing the grab samples the percentages of soil particles are only indicative and not accurate. For accurate assessment of contents in the soil, core sample analysis must be done.

Table 3.4 Soil Sample Analysis Result

Sl No	Sample Position	Depth of Sample Taken in m	Nature of Sample	Soil Texture	Colour	Specific Gravity	% of various size of soil particles			
							Clay	Silt	Sand	Gravel
1	N -1199518 E- 701346	4.5	Disturbed	Silty sand	Light Brown	2.36	9	15	76	0
2	N -1199435 E- 701792	6.5	Disturbed	Silty sand	Light Brown	2.3	9	13	78	0
3	N -1199034 E- 702077	2.5	Disturbed	Silty sand	Light Brown	2.38	8	14	77	0

4	N -1198950 E- 702621	11.2	Disturbed	Silty soil	Ash grey	2.25	25	69	6	0
5	N -1198989 E- 703339	0.7	Disturbed	Silty soil	Ash grey	2.12	25	69	6	0
6	N -1199650 E- 703033	3.7	Disturbed	Sandy soil	Ash grey	2.41	2	7	90	1

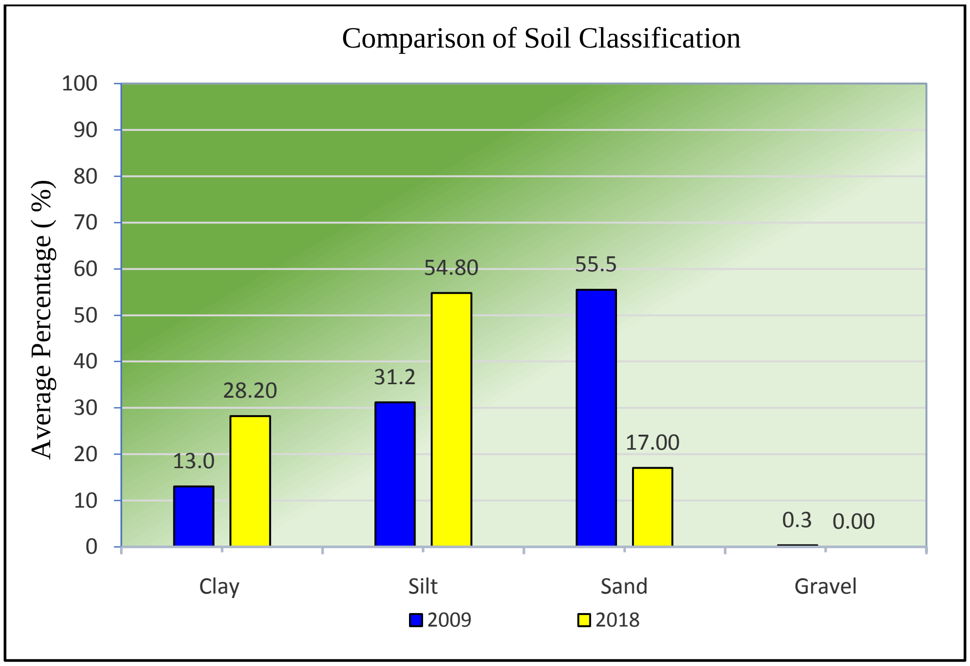


Fig.3.6 Soil particle distribution of the disturbed samples as per two consecutive studies

DISCUSSION

The original Capacity of Walayar Reservoir at 200.66m level is 12.762 Mm^3. The present capacity is 10.65Mm^3. The capacity reduction of the reservoir is 2.112Mm^3 in 62 years at the same level.

- *The sedimentation **Survey in 2009** wasconducted at FRL of 203.0m and the corresponding reservoir capacity was 16.029 Mm^3 against the original volume of 18.4 Mm^3 ie. the capacity was reduced by 2.371 Mm^3 in 53 years @ 0.045 Mm^3/per year.*

- *The capacity corresponding to the present water level of 200.66m was 10.572 Mm^3 and corresponding water spread area was 2.08Sq Km.*

- *The original volume at dead storage level 194.0m was 3.212 Mm^3, and it was reduced to 1.582 Mm^3 in 53 years. Reduction percentage is 50.74%.*
- *The present study is conducted at water level 200.66m and the corresponding capacity is 10.65 Mm^3 and water spread area is 1.73 Sq Km.*
- *Volume at dead storage level is 1.78 Mm^3. Percentage reduction in dead storage is 44.58 % in 62 years.*
- *The capacity corresponding to each level shows a slight increase comparing with the previous study result. This may be due to the heavy flood occurred in August 2018.*
- *Sediment layer profile of the reservoir area at an interval of 50 m is obtained from the Sub Bottom profiler.*

During the first 53 years of the dam life (in the year 2009) the capacity reduction rate at the level of 200.66m was 0.32% per Year. As per the present study, the reduction rate is 0.24% per year. The decrease in rate may be due to the heavy flood in August, 2018.

C.2.4. SEDIMENTATION STUDY OF KUTTIYADY RESERVOIR USING INTEGRATED BATHYMETRIC SYSTEM (IBS) & SUB BOTTOM PROFILER (REPEAT STUDY)

Results And Discussion

C.2.4.1 ESTIMATION OF CAPACITY

The survey is carried out at the water level of 39.5 m. The original water holding capacity at this level is 77.21Mm^3. As per the current IBS study the volume at the same level is estimated as 48.91$Mm^3$and the corresponding water spread area is 8.56Sq.km. Total capacity reduction of the reservoir is 28.3 Mm^3in 46 years, i.e. the reduction in capacity at the specified level is 36.653 %. The capacity reduction is due to the sediment deposit.

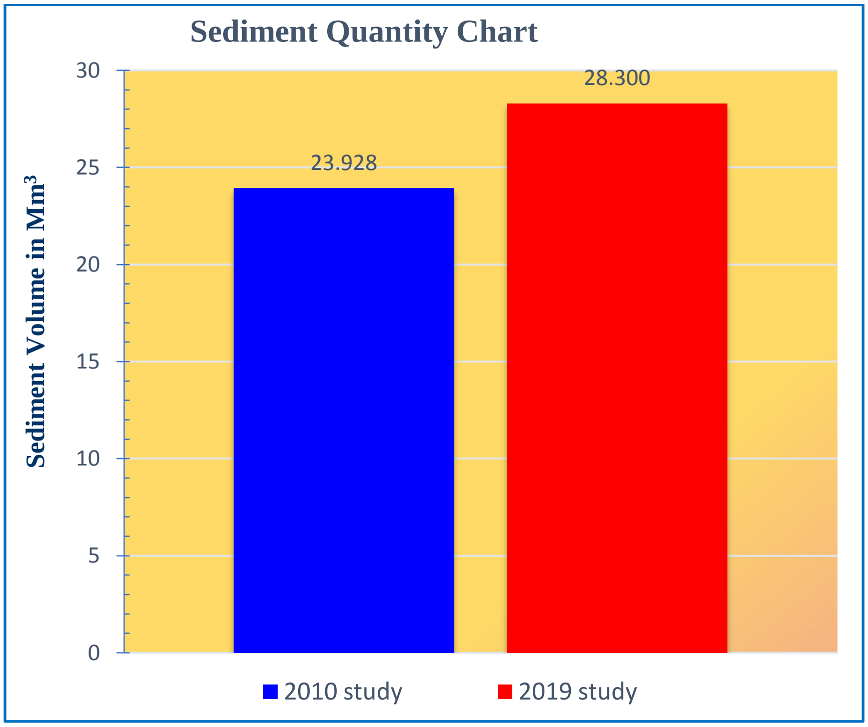


Fig 4.1 Increase in sediment quantity

Table 4 .1 Capacity of the reservoir at WL 39.5m

Year of Study	Capacity In Mm^3	Reduction in Capacity w.r.t Original Volume ($77.21Mm^3$)	
		In Mm^3	In Percentage
2010	53.282	23.928	30.99
2019	48.91	28.3	36.65

The contour map of water spread area is shown in Fig 4.2. at an interval of 2 m

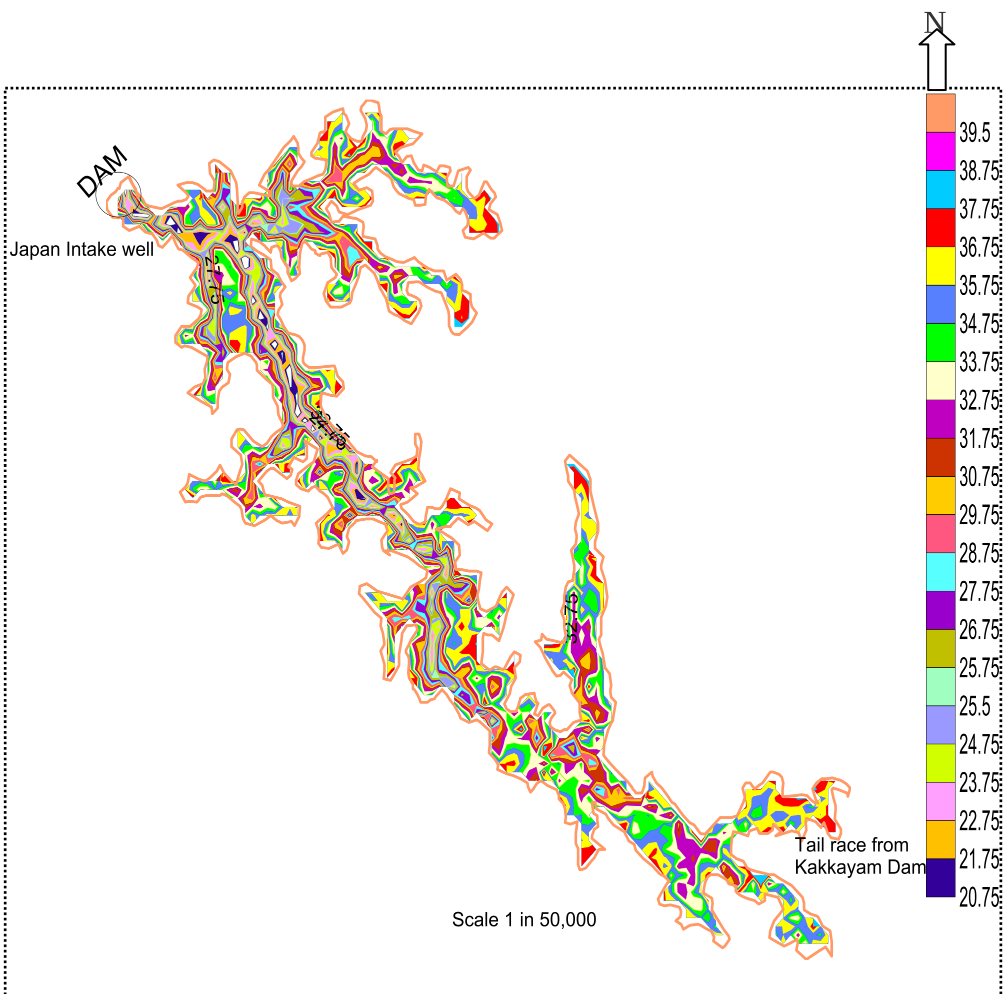


Fig 4.2 Contour map of Kuttiyadi Reservoir based on IBS survey

C.2.4.2 CAPACITY AT DIFFERENT WATER LEVEL

Reservoir volume at different water levels can be found out using the IBS data in Surfer software. The capacity reduction obtained from the IBS is comparable with the sediment volume calculated from the Sub Bottom Profiler. The present capacity at different water levels are compared with the original and IBS result in 2010 and is shown in Table 4.2.

Table 4.2 Reservoir capacity at different water levels.

Sl. No.	Water Level	Water Holding Capacity			Percentage Reduction in Capacity (IBS 2017)
		Original	IBS Survey 2010	IBS Survey 2019	
	m	M. Cub. m	M. Cub. m	M. Cub m	%
1	39.5	77.21	53.282	48.91	36.653
2	38.75	70.924	45.666	42.473	40.115
3	37.75	62.974	36.962	34.924	44.542
4	36.75	55.951	29.749	28.399	49.243
5	35.75	48.404	23.783	22.869	52.754
6	34.75	42.89	18.863	18.308	57.314
7	33.75	37.445	14.823	14.619	60.959
8	32.75	32.584	11.548	11.639	64.280
9	31.75	28.182	8.889	9.221	67.281
10	30.75	23.549	6.799	7.262	69.162
11	29.75	19.447	5.155	5.652	70.936
12	28.75	15.871	3.838	4.317	72.799
13	27.75	12.942	2.797	3.192	75.336
14	26.75	9.948	2.015	2.271	77.171
15	25.75	7.703	1.434	1.531	80.125
16	25.5*	7.278	1.315	1.374	81.121

***Dead Storage Level**

The original storage capacity curve is compared with IBS survey in 2018 as shown in Fig.4.3.

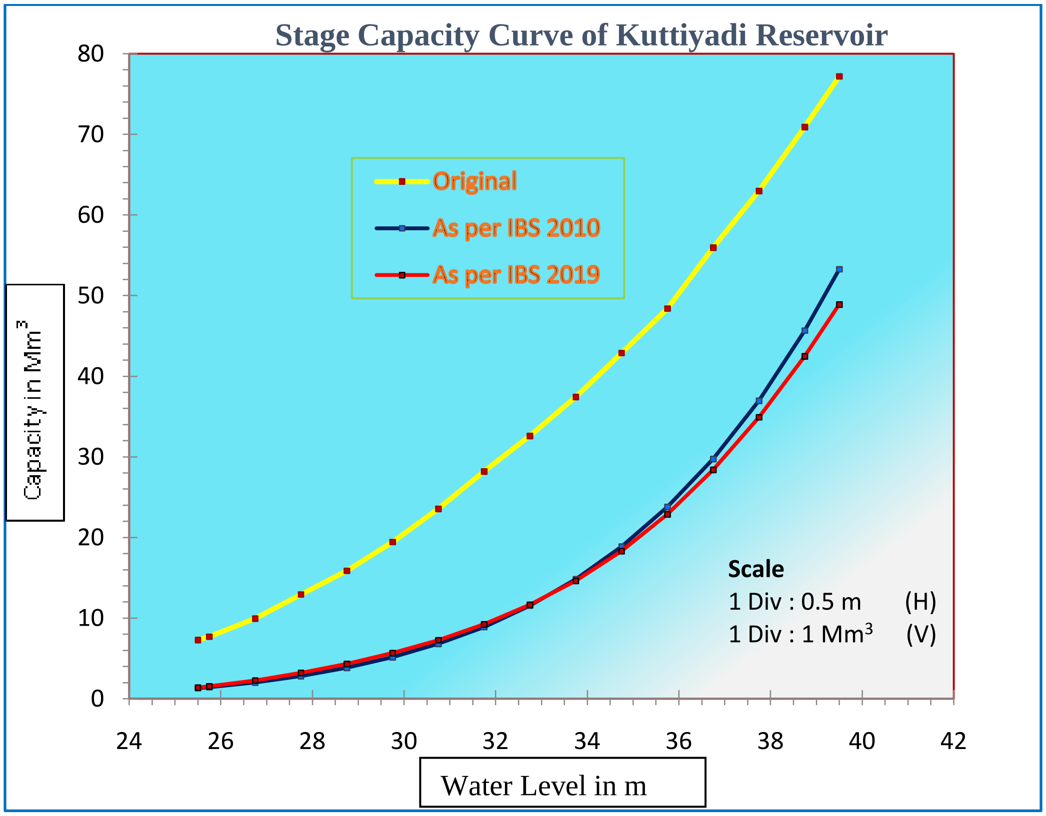


Fig.4.3. Water level v/s Water holding capacity curve

C.2.4.3 WATER SPREAD AREA AT DIFFERENT WATER LEVEL

The present water spread area at different level is compared with the original and is shown in Table 4.3. Fig.4.4 shows its graphical representation

Table 4.3 Water spread area at different water levels.

Sl. No.	Water Level	Water Spread Area	
		IBS Survey 2010	IBS Survey 2019
	m	Sq.km	Sq.km
1	39.5	9.1	8.56
2	38.75	8.47	7.53
3	37.75	7.33	6.71
4	36.75	6.24	5.86
5	35.75	5.27	4.96

6	34.75	4.37	4.1
7	33.75	3.6	3.3
8	32.75	2.91	2.68
9	31.75	2.36	2.17
10	30.75	1.82	1.78
11	29.75	1.46	1.47
12	28.75	1.16	1.23
13	27.75	0.88	1.02
14	26.75	0.66	0.83
15	25.75	0.47	0.64
16	25.5	0.44	0.6

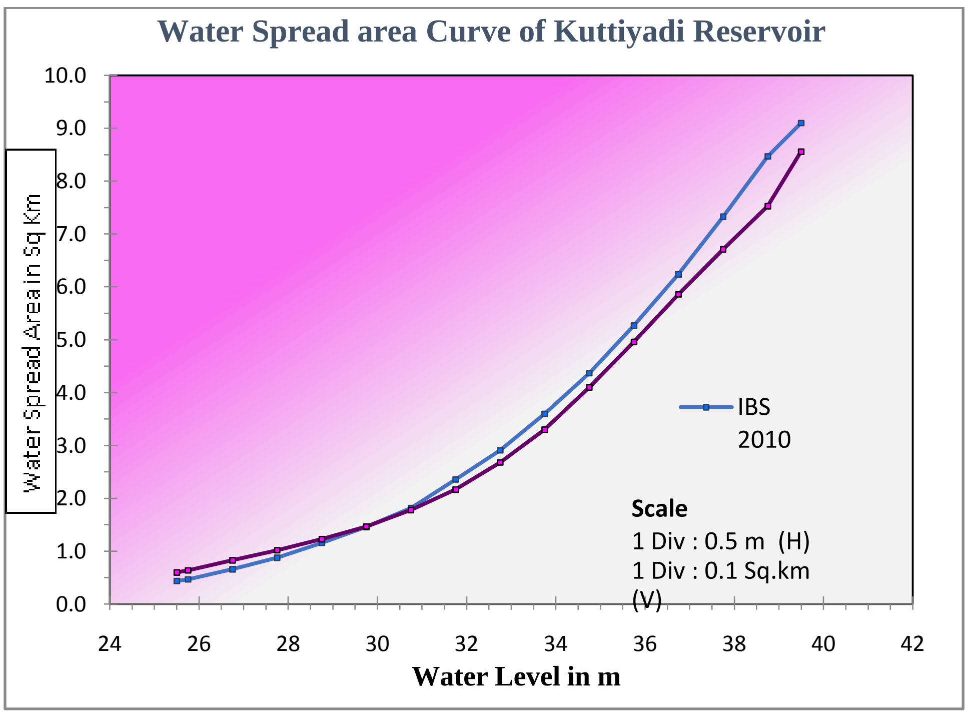


Fig.4.4 Water Level v/s Water Spread Area curve

C.2.4.4 ANALYSIS OF SOIL SAMPLE

The soil samples were analyzed, and result is shown in Table 4.4. In the sedimentation study conducted in 2010, 22 numbers of disturbed soil samples were analyzed. In the present study 17 numbers of soil samples are analyzed. The samples for both the studies were collected from different locations. By comparing the results of two studies, variations are observed in the percentage of Silt and Sand. The average percentage of clay, silt, sand and gravel of the analyzed samples in the two consecutive studies are graphically represented in Fig 4.6.

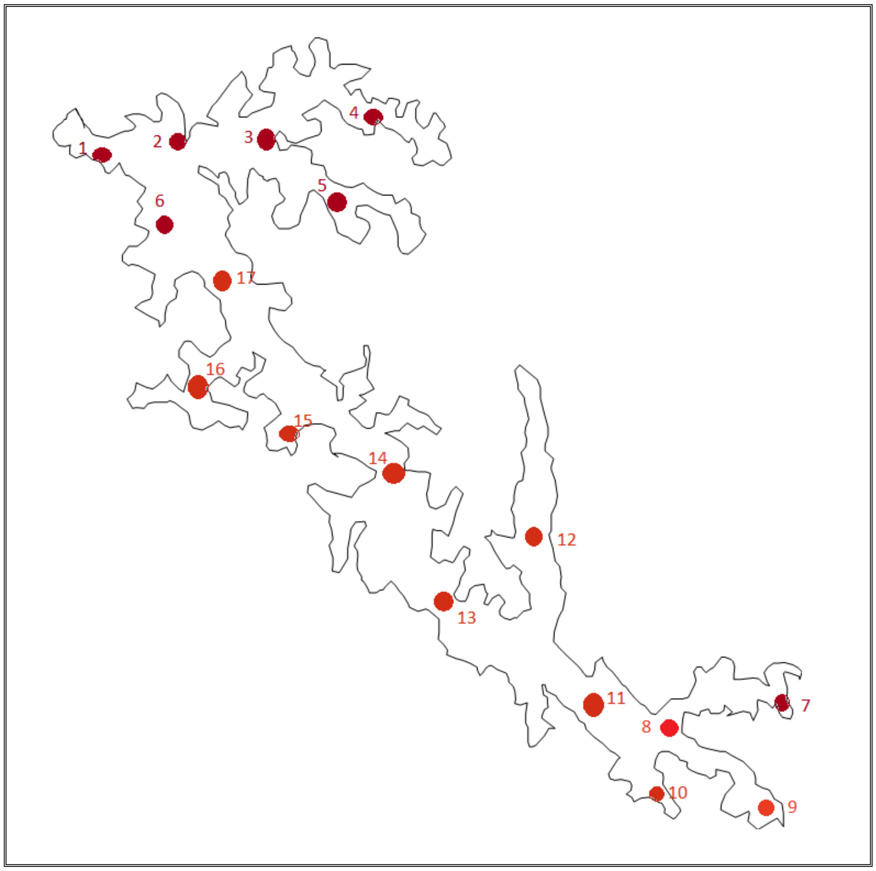


Fig.4.5 Location of Soil Samples

Table 4.4 Soil Sample Analysis Result

Sl no	Sample Position	Depth of Sample Taken in m	Nature of Sample	Soil Texture	Colour	Specific Gravity	% of various size of soil particles			
							Clay	Silt	Sand	Gravel
1	N- 1281733 E-589994	8.1	Disturbed	Silty Soil	Light buff	2. 41	19	77	4	0
2	N- 1281812 E-590677	14.0	Disturbed	Silty Soil	Light brown	2.05	33	61	6	0
3	N-1281822 E-591291	11.3	Disturbed	Silty Soil	Light brown	2.1	25	55	20	0

4	N-1282085 E-592355	5.7	Disturbed	Silty Soil	Light brown	2.15	22	71	7	0
5	N-1281397 E-592026	8.4	Disturbed	Sandy Soil	Light brown	2.2	7	27	65	1
6	N-1281393 E-590508	16.5	Disturbed	Silty Soil	Light brown	2.18	24	68	8	0
7	N-1276935 E-595951	1.6	Disturbed	Sandy Soil	Light brown	2.26	4	35	61	0
8	N-1276872 E-594878	6.8	Disturbed	Silty Soil	Light brown	2.18	7	51	42	0
9	N-1276174 E-595642	4.5	Disturbed	Silty Soil	Light brown	2.04	16	81	3	0
10	N-1276292 E-594751	6.9	Disturbed	Silty Soil	Light brown	2.07	23	61	16	0
11	N-1277195 E-594017	7.3	Disturbed	Silty Soil	Light brown	2.21	8	43	49	0
12	N-1278398 E-593712	7.4	Disturbed	Silty Soil	Light brown	2.08	28	63	8	1
13	N-1277895 E-592961	7.9	Disturbed	Sandy Soil	Light brown	`2.13	9	32	58	1
14	N-1279126 E-592438	11.8	Disturbed	Silty Soil	Light brown	2.06	21	56	23	0
15	N-1279767 E-591428	11.5	Disturbed	Silty Soil	Light brown	2.1	29	63	8	0
16	N-1279739 E-590872	10.1	Disturbed	Silty Soil	Light brown	2.14	15	48	37	0
17	N-1280802 E-590918	11.6	Disturbed	Silty Soil	Light brown	2.11	19	55	26	0

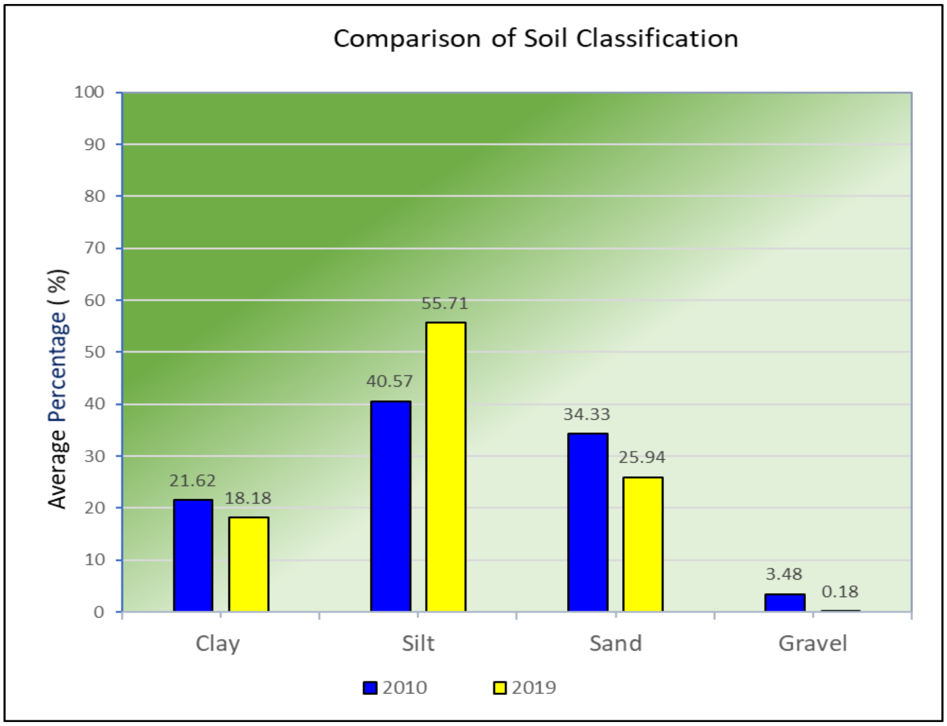


Fig.4.6Comparison of soil particle distribution as per two consecutive studies

Since we are analyzing the grab samples the percentages of soil particles are only indicative and not accurate. For accurate assessment of contents in the soil, core sample analysis must be done.

DISCUSSION

The original Capacity of Kuttiyadi Reservoir at 39.5m level is 77.21Mm$^{3.}$ The present capacity is 48.91Mm^3. The capacity reduction of the reservoir is 28.3Mm^3 in 46 years at the same level.

- ***As per the IBS Survey 2010, the Reservoir capacity was 53.282Mm^3 at 39.5m and Capacity was reduced by 23.928Mm^3 in 37 years @ 0.647Mm^3/per year.***
- ***The water spread area corresponding to 39.5m was 9.1Sq.km.***
- ***The original volume at dead storage level (25.5m) was 7.278Mm^3, volume reduced to 1.315Mm^3 in 37 years. Reduction percentage is 81.93%.***

- ***In the present study, the Reservoir capacity is 48.91Mm^3 at the water level of 39.5m and capacity is reduced by 4.372Mm^3 in 9 years @ 0.486 Mm^3/per year.***

- ***The water spread area corresponding to 39.5m is reduced from 9.1 Sq.km to 8.56 Sq. Km in 9years.***

- ***Volume at dead storage level is 1.374 Mm^3, Percentage reduction in dead storage is 81.12% in 46 years. The dead storage capacity is slightly more than the same obtained in the previous study.***

- ***Comparing with the previous study result, the storage capacity shows a decrease from the WL of 39.5m to 33.75m. From this level to the dead storage level the capacity shows an increase. This may be due to the effect of the mining action taking place in that region by the KSEB and may be the effect of the heavy flood occurred in 2018.***

- ***Sediment layer profile of the reservoir area at an interval of 75m is obtained from the Sub Bottom profiler.***

- ***21 Nos. of profiles in the U/S side of the dam at an average interval 25m for a length of 500m is prepared and attached as Annexure I.***

During the first 37 years of the dam life the capacity reduction rate was 0.84% per Year. Within the next 9 years, the reduction rate is 0.63 % per year. This rate reduction based on the survey conducted in 2019 may be due to the effect of the flood occurred in the year 2018.

The graphical representation of reduction and rate is shown in Fig.8.1

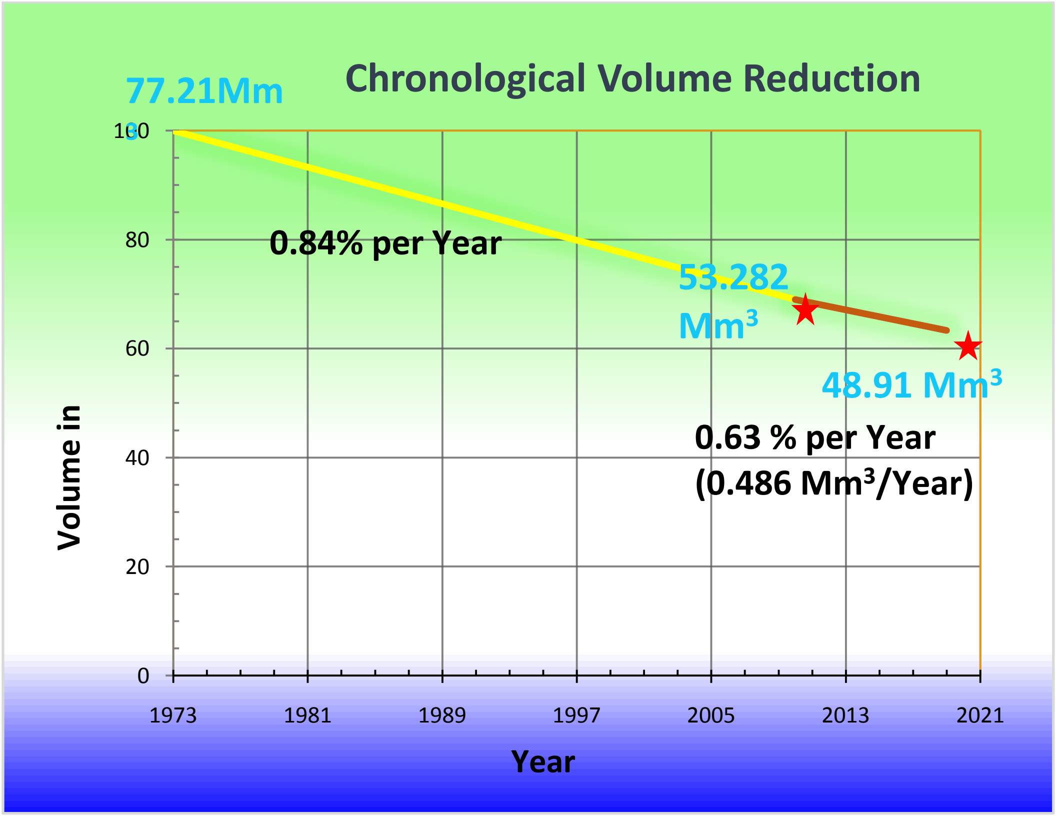


Fig.4.7 Chronological Volume Reduction

C.2.5 SEDIMENTATION STUDY OF BOOTHATHANKETTU BARRAGE USING INTEGRATED BATHYMETRIC SYSTEM (IBS) & SUB BOTTOM PROFILER

Results And Discussion

C.2.5.1 ESTIMATION OF CAPACITY

The survey is carried out at the water level of 34.2m. The storage capacity of the barrage at this level is 43.491 Mm^3. The original water holding capacity at this level is not available to compare.

The contour map of water spread area is shown in Fig 5.1 at an interval of 0.5m

N

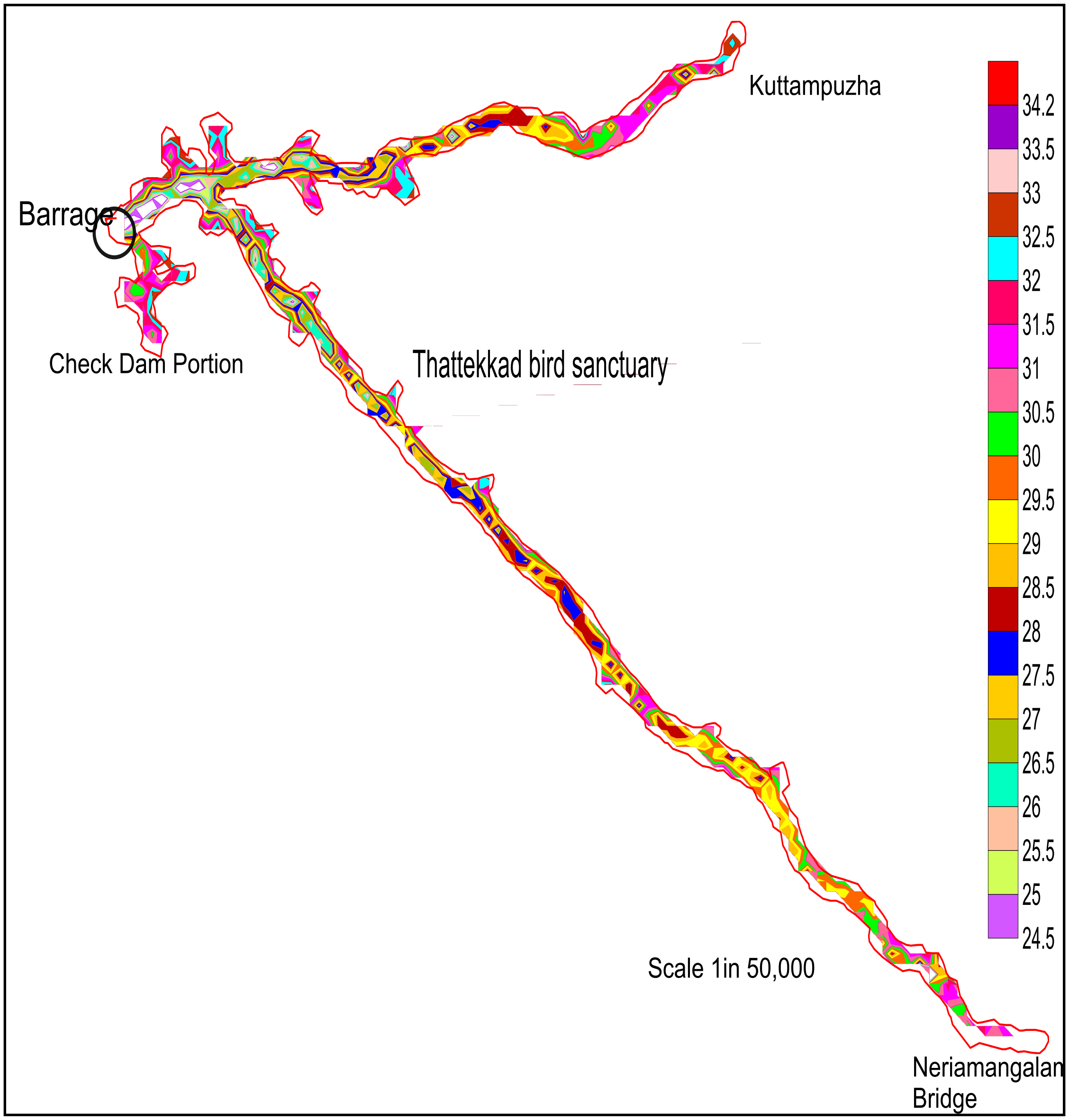


Fig 5.1 Contour map of Boothathankettu Barrage based on IBS survey

C.2.5.2 CAPACITY AT DIFFERENT WATER LEVEL

The storage capacity at different water levels can be found out using the IBS data in Surfer software and is shown in Table 5.1

Table 5.1 Storage capacity at different water levels.

Sl. No.	Water Level	Percentage Reduction in Capacity (IBS 2017)
		Original
	m	M. Cub. m
1	34.2	43.491
2	34	41.61
3	33.5	36.907
4	33	32.208
5	32.5	27.597
6	32	23.204
7	31.5	19.111
8	31	15.416
9	30.5	12.229
10	30	9.485
11	29.5	7.134
12	29	5.216
13	28.5	3.737
14	28	2.625
15	27.5	1.829
16	27	1.249
17	26.5	0.849
18	26	0.577
19	25.5	0.394
20	25	0.27
21	24.5	0.185
22	24	0.136
23	23.5	0.109
24	23	0.093

The original storage capacity curve is compared with IBS survey in 2018 as shown in Fig.5.2.

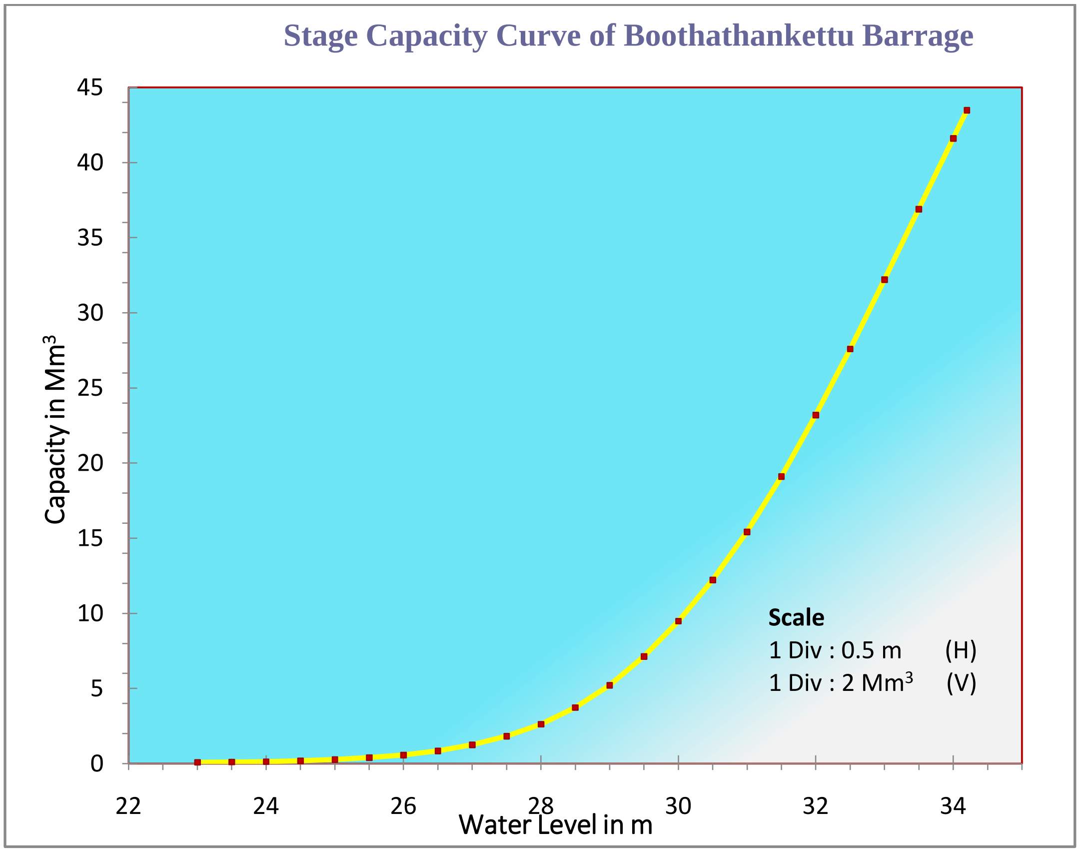


Fig.5.2. Water level v/s Water holding capacity curve

C.2.5.3 WATER SPREAD AREA AT DIFFERENT WATER LEVEL

The present water spread area corresponding to different water level is shown in Table 5.2. Fig.5.3 shows its graphical representation.

Table 5.2 Water spread area at different water levels.

Sl. No.	Water Level	Water Spread Area	Sl. No.	Water Level	Water Spread Area
	(m)	(Sq. Km)		(m)	(Sq. Km)
1	34.2	5.8	**13**	28.5	2.13
2	34	5.78	**14**	28	1.55
3	33.5	5.75	**15**	27.5	1.12
4	33	5.74	**16**	27	0.81

5	32.5	5.67	**17**	26.5	0.55
6	32	5.46	**18**	26	0.36
7	31.5	5.19	**19**	25.5	0.230
8	31	4.78	**20**	25	0.15
9	30.5	4.3	**21**	24.5	0.09
10	30	3.8	**22**	24	0.05
11	29.5	3.3	**23**	23.5	0.03
12	29	2.72	**24**	23	0.02

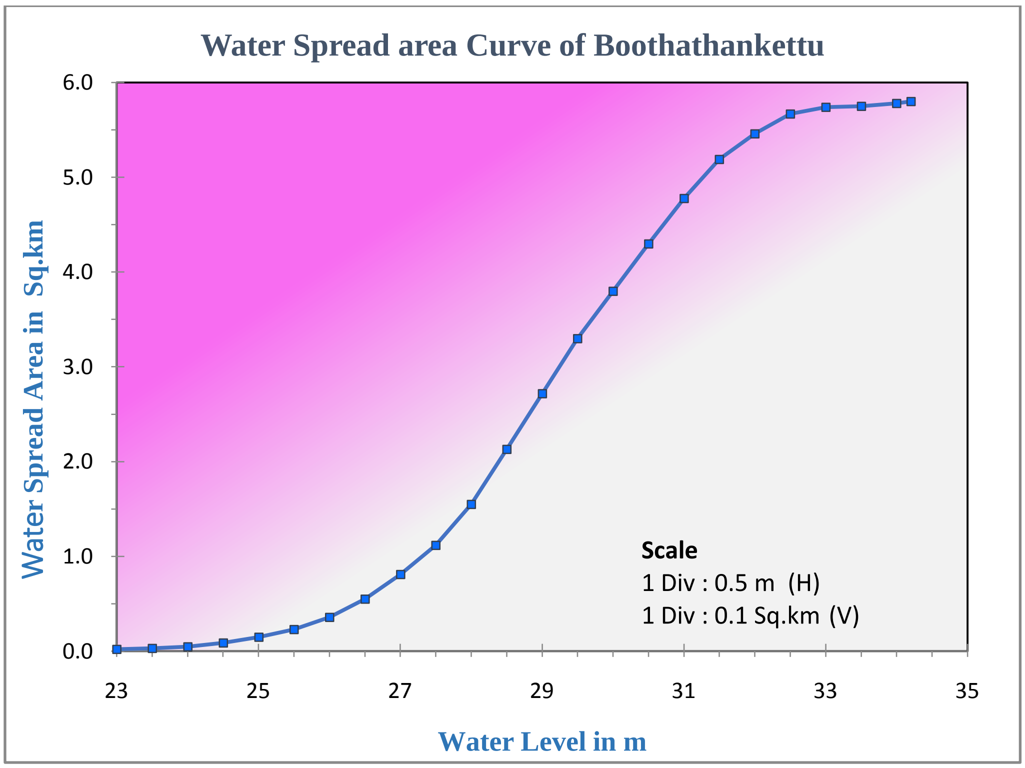


Fig.5.3 Water Level v/s Water Spread Area curve

C.2.5.4 ANALYSIS OF SOIL SAMPLE

The soil samples were analyzed, and result is shown in table 5.3. The average percentage of clay, silt, sand and gravel of the analyzed samples in the two consecutive studies are graphically represented in Fig 5.5.

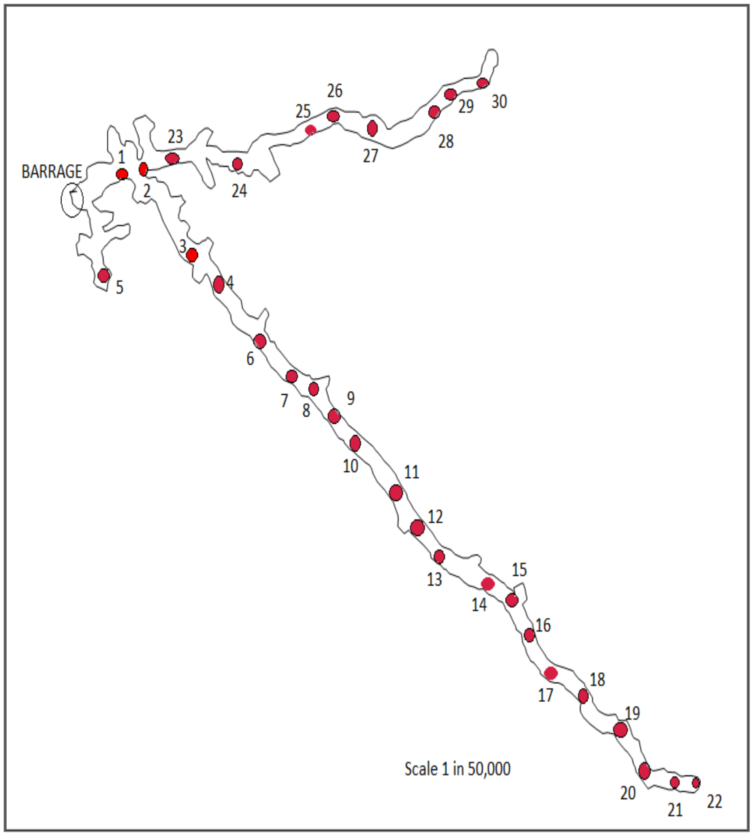


Fig.5.4 Location of Soil Samples

Table 5.3 Soil Sample Analysis Result

Sl No	Sample Position	Depth of Sample Taken in m	Nature of Sample	Soil Texture	Colour	Specific Gravity	% of various size of soil particles			
							Clay	Silt	Sand	Gravel
1	N- 1121502 E-683083	8.8	Disturbed	Sandy Soil	Light brown	2.49	1	3	96	0
2	N- 1121536 E-683594	8.2	Disturbed	Sandy Soil	Light brown	2.45	1	3	96	0
3	N-1120717 E-684071	7.6	Disturbed	Sandy Soil	Light brown	2.39	2	3	95	0
4	N-1120044 E-684781	8	Disturbed	Sandy Soil	Light buff	2.5	0	2	98	0
5	N-1119629	4.5	Disturbed	Silty	Light	2.26	4	15	81	0

	E-685250			Sand	brown					
6	N-1119103 E-685774	6.8	Disturbed	Sandy Soil	Light brown	2.48	1	4	92	3
7	N-1118669 E-686273	6.9	Disturbed	Sandy Soil	Light buff	2.58	1	1	95	3
8	N-1118408 E-686712	7.2	Disturbed	Sandy Soil	Light buff	2.53	0	1	99	0
9	N-1118009 E-687203	6.8	Disturbed	Sandy Soil	Light buff	2.46	0	1	99	0
10	N-1117530 E-687731	7.3	Disturbed	Sandy Soil	Light buff	2.59	0	2	98	0
11	N-1117080 E-688264	5.8	Disturbed	Sandy Soil	Light buff	2.54	0	0	99	1
12	N-1116497 E-688804	6.4	Disturbed	Silty Soil	Light brown	2.4	4	16	80	0
13	N-1115969 E-689355	6	Disturbed	Sandy Silt	Light brown	2.44	2	53	45	0
14	N-1115700 E-689875 E-690410	5.6	Disturbed	Sandy Soil	Light buff	2.56	0	0	100	0
16	N-1114993 E-691037	4.8	Disturbed	Sandy Soil	Light buff	2.57	0	1	96	3
17	N-1114192 E-691672	4.2	Disturbed	Sandy Soil	Light buff	2.55	1	0	94	5
18	N-1113686 E-692421	3.2	Disturbed	Sandy Silt	Light brown	2.44	2	58	40	0
19	N-1113373 E-692995	4.6	Disturbed	Sandy Soil	Light buff	2.54	0	0	91	9
20	N-1112859 E-693542	2.2	Disturbed	Sandy Silt	Light brown	2.42	2	52	46	0
21	N-1112557 E-693936	3.4	Disturbed	Sandy Soil	Light buff	2.4	1	0	93	6

22	N-1112641	1.8	Disturbed	Sandy Soil	Light brown	2.58	2	2	94	2
	E-694542									
23	N-1121720	7.8	Disturbed	Sandy Soil	Light buff	2.51	0	1	91	8
	E-683983									
24	N-1121702	7.3	Disturbed	Sandy Silt	Light brown	2.33	4	59	35	2
	E-685566									
25	N-1122155	6.2	Disturbed	Sandy Silt	Light brown	2.22	4	64	28	4
	E-686805									
26	N-1122299	5.9	Disturbed	Sandy Soil	Light buff	2.49	0	0	100	0
	E-687382									
27	N-1122134	4.9	Disturbed	Sandy Soil	light brown & Light buff	2.38	1	2	97	0
	E-688161									
28	N-1122660	3.5	Disturbed	Sandy Soil	light brown & Light buff	2.55	1	0	99	0
	E-689702									
29	N-1122719	2.6	Disturbed	Sandy Soil	light brown & Light buff	2.55	0	1	99	0
	E-689995									
30	N-1122945	1.9	Disturbed	Sandy Soil	light brown & Light buff	2.48	1	3	96	0
	E-690448									

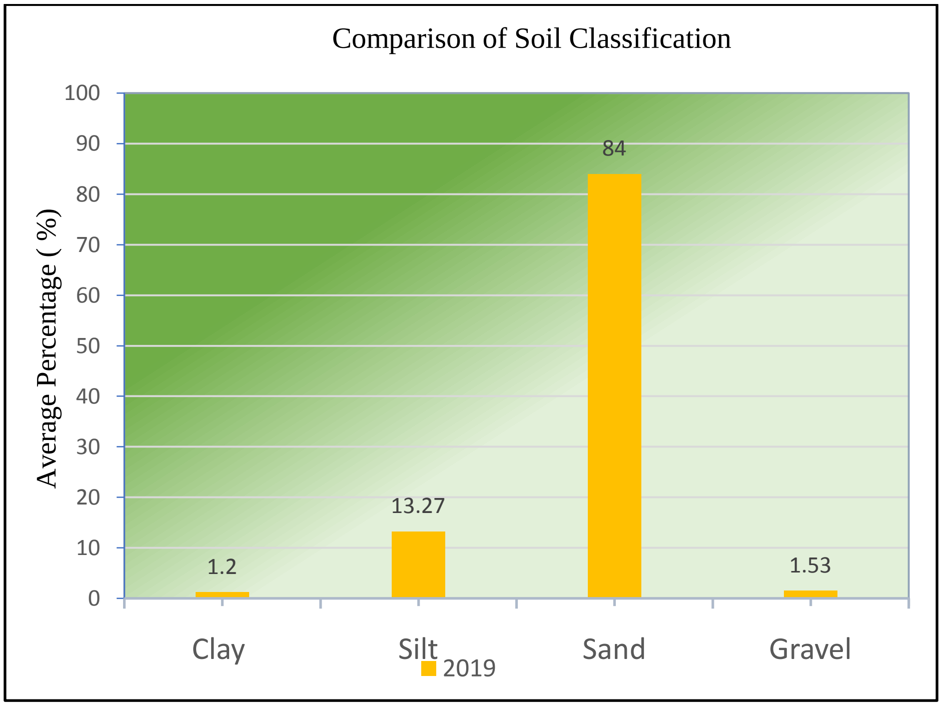


Fig.5.5 Soil particle distribution as per two consecutive studies

Since we are analyzing the grab samples the percentages of soil particles are only indicative and not accurate. For accurate assessment of contents in the soil, core sample analysis must be done.

DISCUSSION

- ♣ *The present storage capacity of Boothathankettu Barrage at the water level of 34.2m is 43.491 Mm$^{3.}$ The initial storage data corresponding to various water levels are not available and hence comparison cannot be done.*

- ♣ *The present survey area extended from the Barrage to the Kuttanpuzha town through the Kuttanpuzha River and to the Nariyamangalam Bridge through the Periyar River. In between these area The corresponding water spread area is 5.8 Sq. Km.*

- ♣ *Sediment layer profile of the reservoir area at an interval of 100m is obtained from the Sub Bottom profiler.*

- ♣ *20 nos of disturbed soil samples were analyzed and the average percentage of Clay, Silt, Sand and Gravel are1.2, 13.27, 84 and 1.53 respectively.*

C.3. WORKS CARRIED OUT DURING FY 2019-20

C.3.1 BATHYMETRIC SURVEY AT AKKULAM- VELI LAKE USING INTEGRATED BATHYMETRIC SYSTEM

Sedimentation Division, of KERI conducts studies to compute the present capacity of reservoirs and other water bodies.

- ***To quantify or determine the present capacity of Akkulam –Veli lake using IBS.***
- ***Cross sectional details of the lake at an average interval of 40m.***
- ***Assessing the quantity of silt to be removed from the lake in order to maintain a minimum water depthof 2m.***

The work was started on 26/08/2019 and completed 05/09/2019.

STUDY AREA

Akkulam Lake

Akkulam Lake is a backwater area in the Veli Lake joining with the sea, at Thiruvananthapuram in Kerala, India. It is about 10 km from Thiruvananthapuram city center. It is fed by Amayizhanchanthodu and Kulathur stream. Akkulam Tourist village and Akkulam Boat Club are the major picnic spots in the area.

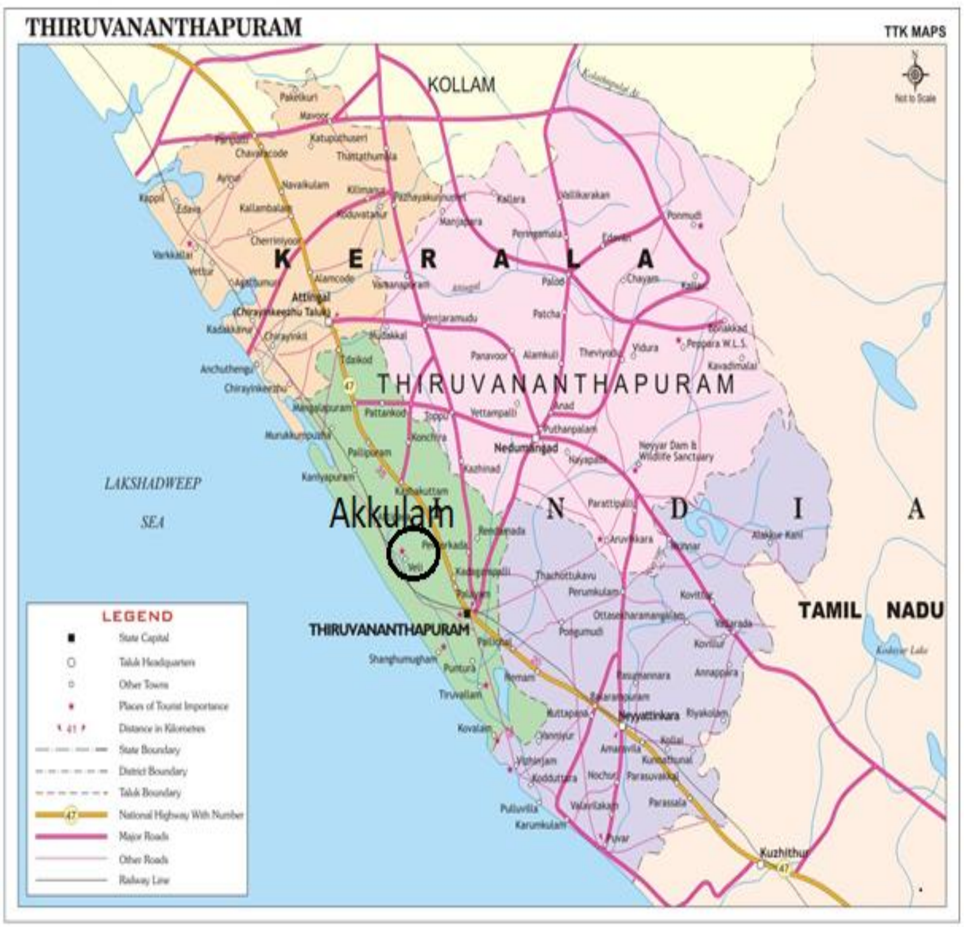


Fig 4.1 Location map of Akkulam-Veli Lake

The backwater of Veli-Akkulam, adjoining the Arabian Sea in the south-west part of Indian Peninsula, is a coastal wetland system and forms an integral part of the local ecosystem. In addition to the usual marine interactions, this water body is subjected to anthropogenic interference due to their proximity to the Thiruvananthapuram City urban agglomeration.

Fig.8 View of Akkulam Lake

C.3.1.1 HYDROGRAPHIC SURVEY

All the settings were done in the mobile station for the survey.Accurate positioning of the boat was reached using Global Positioning System (GPS).By using the QINSY software chart is prepared by taking UTM (Universal Transverse Mercator:-A special transverse Mercator grid which divides the world in to 6°zones of Longitude).Co-ordinate of two points for drawing a reference line which extend up to the boundary of the reservoir area. With this coordinate of two points reference line is drawn. Segment lines are drawn parallel to this reference line at an interval of 35cm such that the entire reservoir area can be covered.

The survey was conducted along the predetermined segment lines after setting the data logging software to record the data from the Echo Sounder at 1m intervals. The boat was sailed along the track maintaining a speed of 3 to 4 knots. The depth of water and its corresponding position is recorded simultaneously at each point. The software enables generation of depth profile and overviews using the data recorded (fig 4.1)

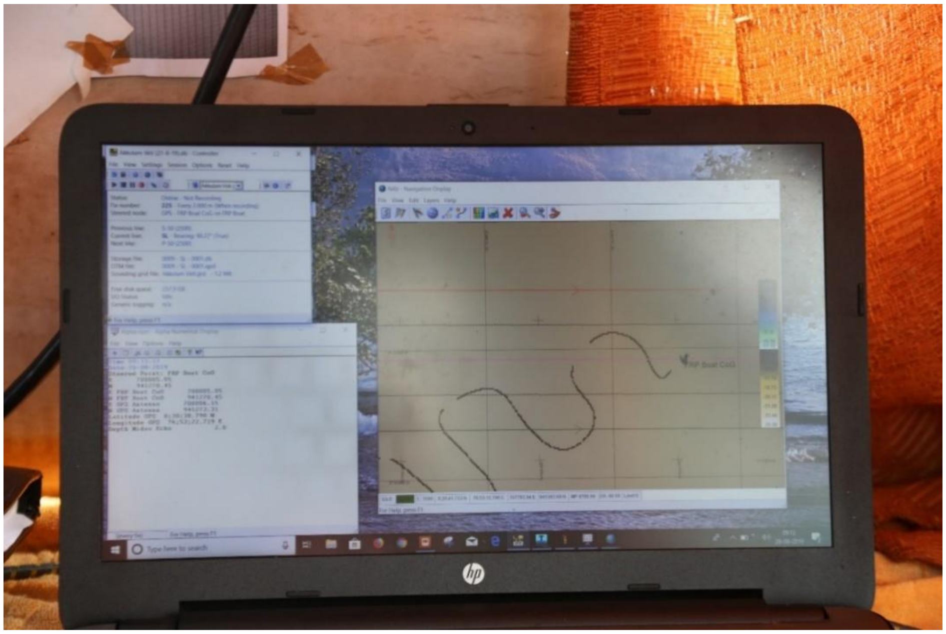


Fig.1.1 Data Acquisition in Qinsy

The data is then edited to eliminate spurious readings caused due to violent winds and waves using the data processor in Qinsy (fig 4.2).

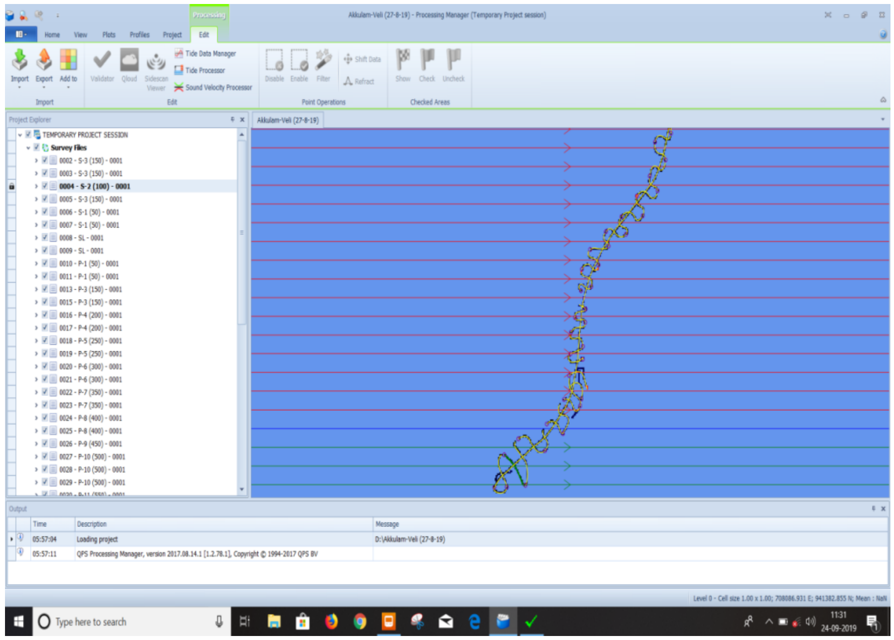


Fig.1.2 Data Processing

All the validated data (fig.4.3) are exported using Data Export program and it is processed in Surfer Software. This exported data converts in to grid data by triangulation with linear interpolation method.

Using the grid data contour maps is drawn and volume is calculated at specified intervals.

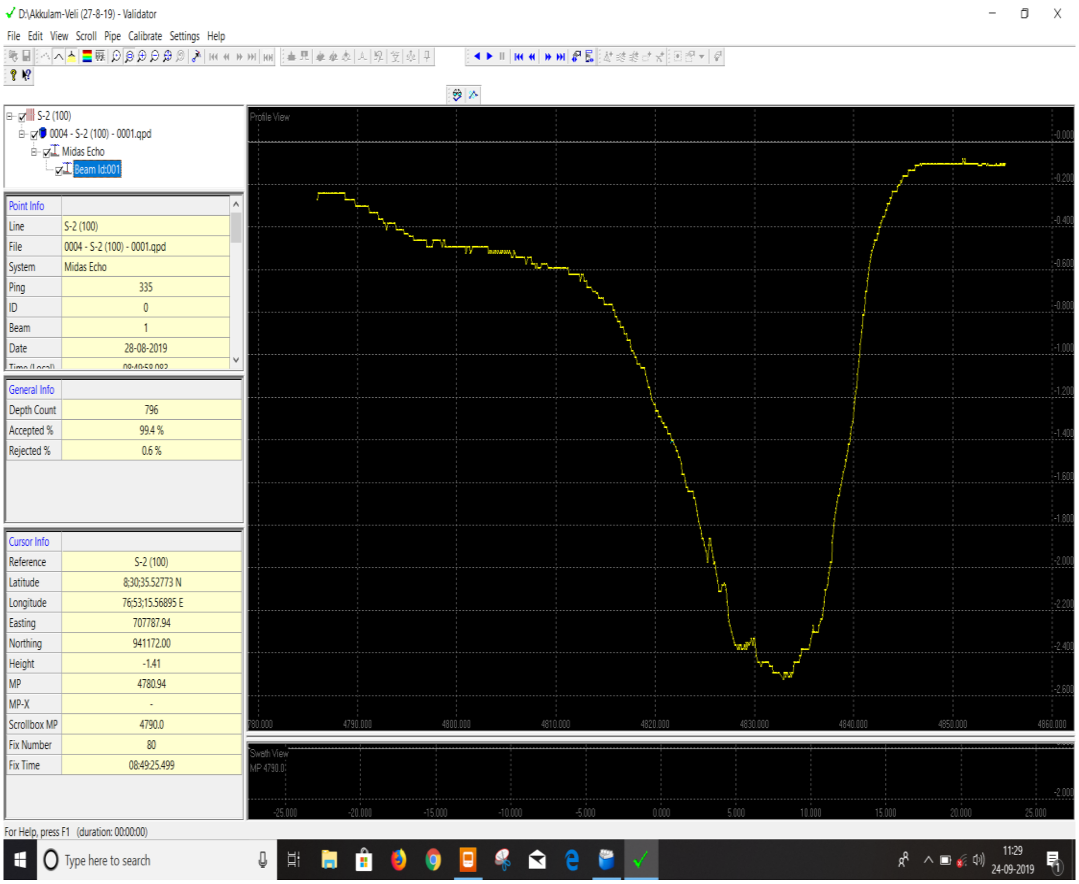


Fig.1.3 Data Validation

The Water spread area map of surveyed portion digitized from the IBS data in Surfer software is shown in fig 1.4.

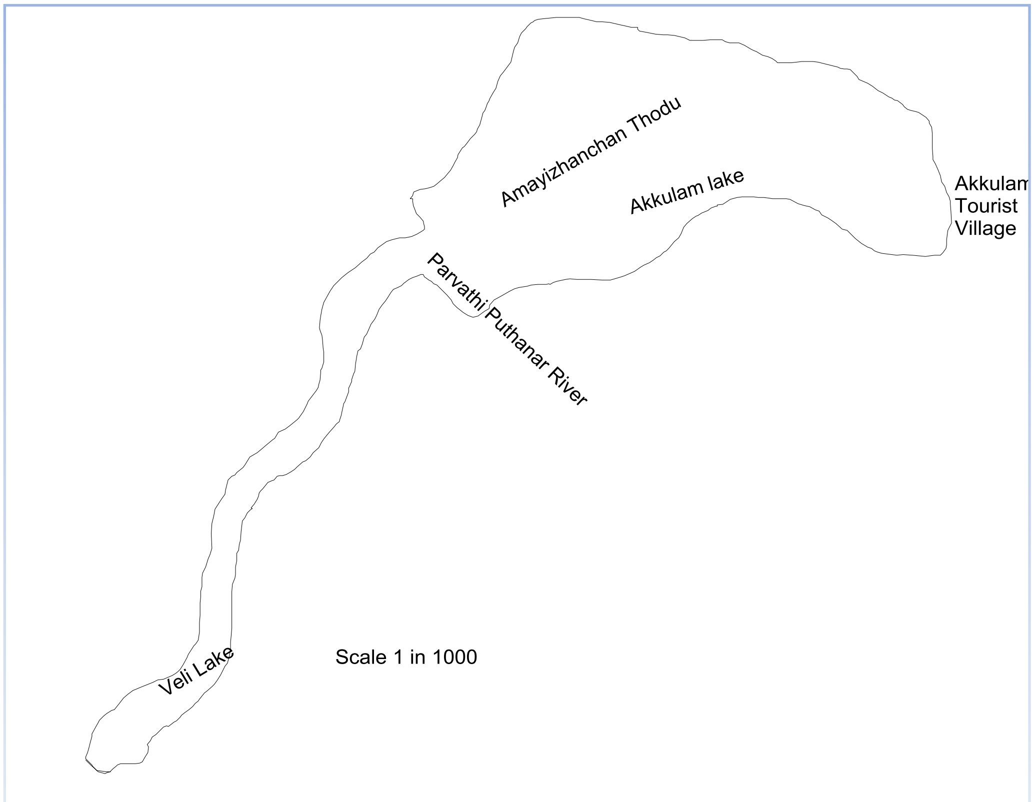


Fig 1.4 Water spread Area Map of Akkulam- Veli Lake (surveyed portion)

C.3.1.2 ESTIMATION OF CAPACITY

The Water Spread area of the surveyed portion is estimated as 0.57Sq.km and the corresponding volume is 0.640Mm^3.

The contour map of water spread area is shown in Fig 1.5 at an interval of 0.2m

N

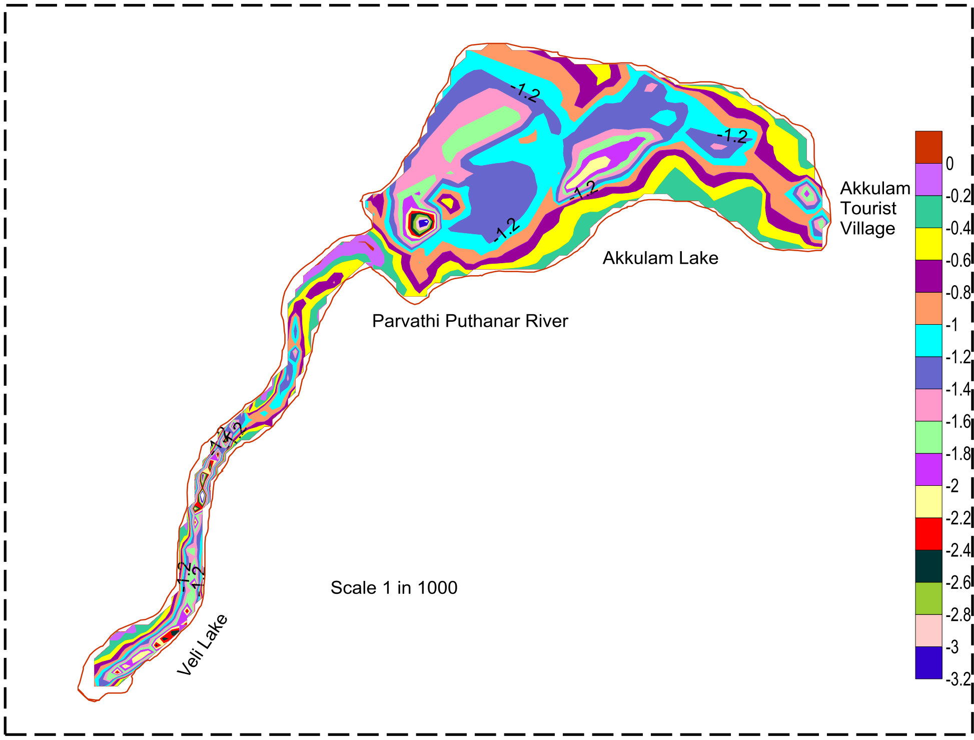


Fig 1.5 Contour map of Akkulam- Veli Lake based on IBS survey

C.3.1.3 CONCLUSION

The Bathymetric survey of Akkulam Veli Lake was conducted from 26th August to 5th September, 2019.The sedimentation study is carried out using IBS and the results are reported herein.

C.3.2 SEDIMENTATION STUDY OF NEYYAR RESERVOIR USING INTEGRATED BATHYMETRIC SYSTEM & SUB BOTTOM PROFILER

Sedimentation Division, of KERI conducts studies to compute the present capacity of reservoirs and other water bodies

- ***To quantify or determine the present capacity of Neyyar reservoir using IBS.***
- ***To find the quantity of sediment and its Distribution in the reservoir using Sub Bottom Profiler.***

- ***To compare the present result with the previous study result, for analyzing the chronological sedimentation behavior of the reservoir.***

SALIENT FEATURES

1.	Name	:	Neyyar
2.	Location	:	77^0 09" E
	Longitude	:	
	Latitude	:	$8^0$32"N
3.	Year of commencement	:	1952
4.	Year of completion	:	1964
5.	Type of Dam	:	Straight gravity Masonry Dam
6.	Maximum height of Dam	:	50.6m
7.	Length of Masonry Dam	:	294.83m
8.	Catchment Area	:	140.00 Sq.km
9.	Maximum storage	:	106.188 Mm^3
10.	Dead storage	:	10.524 Mm^3
11.	Water spread area	:	9.10 Sq.km
12.	Full reservoir level	:	84.734m from MSL
13.	Minimum Draw Down level	:	65.00m
14.	Normal bed level	:	46.93m
15.	Purpose	:	Irrigation and drinking

Data collection completed. Report under preparation.

C.3.3 SEDIMENTATION STUDY OF VAZHANI RESERVOIR USING INTEGRATED BATHYMETRIC SYSTEM & SUB BOTTOM PROFILER

Sedimentation Division, of KERI conducts studies to compute the present capacity of reservoirs and other water bodies.

- ***To quantify or determine the present capacity of Vazhani reservoir using IBS.***
- ***To find the quantity of sediment and its Distribution in the reservoir using Sub Bottom Profiler.***

- ***To compare the present result with the previous study result, for analyzing the chronological sedimentation behavior of the reservoir.***

- ***To Study the soil particle distribution from the various parts of the reservoirs***

SALIENT FEATURES

1.	Name	:	Vazhani
2.	Location		
	Longitude	:	76^{o} 19' E
	Latitude	:	10^{o} 38' N
3.	Year of commencement	:	1951
4.	Year of completion	:	1959
5.	Type of Dam	:	Earth dam
6.	Length of Dam	:	792.48m
7.	Catchment area	:	20.48 Sq.km.
8.	Maximum storage	:	18.121 Mm^3
9.	Dead storage	:	1.471Mm^3
10.	Water spread area	:	1.82 Sq.km.
11.	Maximum water level	:	62.48m from MSL
12.	Bed level	:	39.62m
13.	Sill of canal	:	45.72m
14.	Deepest foundation level	:	28.950 m
15.	Purpose	:	Irrigation

Data collection completed. Report under preparation.

C.3.4 SEDIMENTATION STUDY OF MALAMPUZHA RESERVOIR USING INTEGRATED BATHYMETRIC SYSTEM & SUB BOTTOM PROFILER

Sedimentation Division, of KERI conducts studies to compute the present capacity of reservoirs and other water bodies

- *To quantify or determine the present capacity of Malampuzha reservoir using IBS.*

- *To find the quantity of sediment and its Distribution in the reservoir using Sub Bottom Profiler.*

- ♠ *To compare the present result with the previous study result, for analyzing the chronological sedimentation behavior of the reservoir.*
- ♠ *To Study the soil particle distribution from the various parts of the reservoirs.*

SALIENT FEATURES

1.	Name	:	Malampuzha
2.	Location	:	
	Longitude between	:	76^o 39'E and 76^o 42'E
	Latitude between	:	10^o 40'N and 10^o 55'N
3.	Year of starting	:	1949
4.	Year of commissioning	:	1955
5.	Year of completion	:	1966
6.	Type of Dam	:	Straight gravity Masonry dam and Earthen dam of zonal type
7.	Length of Masonry Dam	:	1849m
8.	Length of Earthen Dam	:	222.20m
9.	Maximum height of Dam	:	38.10m.
10.	Catchment Area	:	147.63 km^2
11.	Maximum storage	:	226 Mm^3
12.	Dead storage	:	2.40 Mm^3
13.	Water spread area	:	22 Sq.km
14.	Purpose	:	Irrigation and drinking waterSupply at Palakkad town

Data collection completed. Report under preparation.

C.3.5 SEDIMENTATION STUDY OF KANHIRAPUZHA RESERVOIR USING INTEGRATED BATHYMETRIC SYSTEM & SUB BOTTOM PROFILER

Sedimentation Division, of KERI conducts studies to compute the present capacity of reservoirs and other water bodies.

- ❖ ***To quantify or determine the present capacity of Kanhirapuzha reservoir using IBS.***

- ***To find the quantity of sediment and its Distribution in the reservoir using Sub Bottom Profiler.***

- ***To compare the present result with the previous study result, for analyzing the chronological sedimentation behavior of the reservoir.***

- ***To Study the soil particle distribution from the various parts of the reservoirs***

SALIENT FEATURES

1.	Name	:	Kanhirapuzha
2.	Location		
	Longitude	:	76^{o} 32'E
	Latitude	:	10^{o} 59'N
3.	Year of starting	:	1961
4.	Year of commissioning	:	1980
5.	Type of Dam	:	Straight gravity Masonry dam withearthen saddle dams
6.	Length of Masonry Dam	:	231.6 m
7.	Length of Earthen Dam	:	1896.4 m
8.	Height of Masonry Dam	:	38 m
9.	Height of Earthen Dam	:	28 m
10.	Full reservoir level	:	97.5 m
11.	Dead storage level	:	77.42 m
12.	Catchment area	:	70 km^2
13.	Maximum storage	:	70 Mm^3
14.	Dead storage	:	1.557 Mm^3
15.	Water spread area	:	5.15 Sq.km
16.	Purpose	:	Irrigation

Data collection completed. Report under preparation.

D. CONSTRUCTION MATERIALS DIVISION

D.1 Introduction

Construction Material Division is one of the sub units of Kerala Engineering Research Institute (KERI) basically engaged in material testing. Testing of construction materials is an essential part for ensuring quality in construction. In addition to the testing of Irrigation dept works, other Government Departments, Central Government Departments, Public Undertakings and various Private agencies are utilizing the facilities of lab for ensuring quality construction. The CM Lab continued to contribute healthy revenue every year to the Government through various tests conducted for clients.The Lab is also functioning as a training centre of the Irrigation Department and providing training programmes and refresher courses for the benefit of department engineers. The training facility extends to other department engineers also. Now the CM Lab is on the process of getting assessment and accreditation of Testing and Calibration Laboratories by the National Accreditation Board Testing and Calibration Laboratories (NABL) in accordance with the international standards. The accreditation from NABL will boost up the status of the Lab and likely to increase the revenue to Government.

D.2 Report of Tests conducted in CM Lab

Construction materials division of KERI deals with testing of construction materials such as cement, aggregates, steel, tiles, bricks, rock, concrete etc., and design of concrete mixes. Also research activities are conducting at this division as and when required. The essentials tests for getting the physical properties of above materials are carrying out at this lab. During the year 2019-20, tests were conducted for 798 samples of concrete cubes, 3Nos. cylindrical concrete specimens, 241 samples of steel rods, 8 samples of aggregates, 51 samples of rock core, 117 samples of solid blocks, 25 samples of paver blocks, 24 samples of cement, 5 samples of bricks, 8 samples of tiles, 8 samples of GI Pipes, 18Nos. elastomeric bearing pads, 3 samples of aluminium sections in this lab. 20Nos. Mix designs were carried out for various agencies.

Modernizing the lab will come true through with the addition of modern instruments which is a must for any Material Testing Lab. The modern equipments for ascertaining the strength of concrete structures using Non Destructive Techniques were available and will help to solve the practical problems arising in the field and creating awareness among the engineering fraternity. The lab is equipped with NDT instrument for Pile Integrity Test. Nondestructive tests like core compressive strength are being conducted to check the strength and deformation characteristics of the existing structures.Conducting Concrete compressive strength is part of ensuring the strength of hardened concrete.

Two Hundred and ninety two test reports were shaped from this division during the Financial year 2019-2020 earning a revenue of **Rs.11,29,446**/- (Rupees Eleven lakhs twenty nine thousand four hundred and forty six).These materials were brought by various government as well as private entities.

Details of test conductedduring the year 2019-20 are given in Appendix III.

D.3 Field work conducted during the year 2019-20

1. Pile echo test for the work of Reconstruction of Navigational Lock cum Bridge at Thrikkunnapuzha in **Harippad Constituency.**

2. Two visits as part of Pile Echo Test at the site of Thiruvananthapuram Corporation located at Attukal.

3. Investigation work for assessing the possible reasons of leakage of upstream apron of Attappilly RCB –Preliminary works.

4. Dr. Santhosh Kumar P.T. was included in the team for Urban Flood Management Plan for Cochin Corporation vide order no: HYD/DD1/23/2019-IDRB dated 02.11.2019.

5. Dr. Santhosh Kumar P.T., Deputy Director and Er. Siji T.V, Assistant Director were participated in the Flood damage assessment duty entrusted by the District Collector, Thrissur.

6. Assistance to Deputy Superintendent of Police, Vigilance & Anti Corruption Bureau, Thrissur Unit.

This Office along with Soil Mechanics and Foundation Division office have been nominated to assist the Advocate Commissioner to execute the order of the Honorable Court in the Order dated: 15/03/2018 in OS no. 718/12 on the file of 1st Additional Sub Court, Ernakulam. Inspection was done and report submitted.

D4. Other Activities

D.4.1 Attappady Valley Irrigation Project

Attappady Valley Irrigation Project (AVIP) is a medium irrigation project of Government of Kerala. It intends to construct a concrete gravity dam across Siruvani River at Chittur near Agali in Mannarkkad Taluk of Palakkad District.

Dr. Santhosh Kumar P.T., the former Deputy Director, CM Division was the one of the Team Leader of the DPR preparation team. Er. Siji.T.V, Assistant Director, CM Division had actively involved the DPR preparation team. Both of them received ***Award of appreciation*** from the Honorable Minister of Water Resources Sri. Krishnankutty for their participation in the DPR preparation.

D.4.2 Process of NABL Accrediation

D.4.2.1 Proficiency Tests

As part of NABL certification to the Lab, the determination of the calibration or testing performance of the laboratory or the testing performance of an inspection body against pre-established criteria by means of interlaboratory comparisonknown asProficiency Tests is to be completed. Participation in proficiency testing programmes provides laboratories with an objective means of assessing and demonstrating the reliability of data they are producing. Accredited Proficiency Test providers are enlisted in the website of NABL website.

Since the major test undertaken in the CM lab is compressive strength of Concrete cubes (15cm cube compressive strength), these test was proposed for Proficiency Testing. Communications have been made with the six agencies to ascertain the procedure for Proficiency testing, terms and conditions, rate etc for the above tests on concrete cube.

The proficiency test of concrete cubes were successfully completed and the testing was done by LANDMARK Material testing and research laboratory, G200, RIICO Industrial Area, Mansarovar, Jaipur.

D.4.2.2 Training in Laboratory Quality Management System and Internal Audit as per IS/ISO/IEC 17025:2017

Acquiring trained personalities are essentially required for applying NABLaccreditation. Er. Siji. T.V. completed the above training organized by Bureau of Indian Standards at Bangalore.

D.4.2.3 Infrastructure works

Completed the renovation works of the lab building and steel structural roofing over the building. Laying of paver blocks completed in the courtyard. Separate material reception area was maintained for receiving materials for testing.

An amount of Rs.11.5lakhs was sanctioned in the year 2019-20 for the updating old electrical wiring of the Lab. An Air Conditioner of 1.5Tonne was purchased for carrying out the cement tests under controlled conditions. Separate concrete mix design yard was made for keeping dust free environment in the lab. Necessary fire extinguishers were installed in the lab for safety.

D.4.3 Repair of Joint Director Office Building

The repair of the office building of the Joint Director was completed in the year 2019-20 under the supervision of CM Lab.

D.4.4 Internship Programmes

Several Engineering College students and Polytechnic Students were undergone internship trainings and exposure visits to CM Lab as part of their curriculum and necessary certificates issued by the Joint Director, CM&FE.

Six Civil Engineering students from Govt. Engineering College, Thrissur attended CM Lab for two days 26/06/2019 and 27/06/2019.

Seven Civil Engineering students from Govt. Engineering College, Thrissur attended CM Lab for two days 11/07/2019 and 12/07/2019.

Eight Civil Engineering students from Govt. Engineering College, Thrissur attended CM Lab on 26/07/2019.

Four Civil Engineering students from Christ College of Engineering, Irinjalakkuda, Thrissur attended CM Lab on 30.07.2019.

D.4.5 Minor Irrigation Census

The Assistant Director and Overseers of this Lab have assigned supervision and enumeration duty in association with Minor Irrigation Census.

D.4.6 Trainings

The Division was part of the training programme on "General practices in Soil Investigation and Basic Awareness on Geotechnical and Construction Materials Laboratory Testing" held during 13-15 February 2020 for Assistant Engineers and Assistant Executive Engineers of the Department conducted by Publication Wing, KERI.

Snaps of Activities

Fig 1. Testing of Hollow Blocks

Fig 2. Testing of Cement

Fig 3. View of Joint Director Office building before completion of restoration Works

Fig 4. View of Joint Director Office building after completion of restoration Works

Fig 5. Er. Siji. T. V. receiving Award of Appreciation from the Honorable WRD Minister

Fig 6. Dr. Santhosh Kumar P. T. during presentation of AVIP project

E. SOIL MECHANICS AND FOUNDATIONS DIVISION

Soil, the most unpredictable of all engineering materials also happens to be the all-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 of 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 all important.

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. The soil mechanics laboratory undertakes work from Government agency and private agencies.

During investigation, the soil samples are collected and tested in the laboratory, for finding out index properties and engineering properties like Maximum Dry Density, Optimum MoistureContent, Permeability, Shear strength 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 testing equipment for boring to collect undisturbed soil samples.

Soil samples received from various projects of Irrigation Department,PWD Roads and Buildings, Panchayati Raj institutions, Power Grid, Kerala State Electricity Board, Housing Board and Non-Government bodies are being tested as per the codes of Bureau of Indian Standards.

The Lab contributes healthy revenue every year to the Government through various tests conducted for clients. The Lab is also functioning as a training centre of the Irrigation Department and providing training programmes and refresher courses for the benefit of department engineers. Now the Lab is on the process of getting assessment and accreditation of Testing and Calibration Laboratories by the National Accreditation Board Testing and Calibration Laboratories (NABL) in accordance with the international standards.Also research activities are being conducted at this division.

Tests conducted in the Lab

Soil samples were tested from various projects of Irrigation department, other departments and private agencies. During the year 2019-20, 552 sample tests were conducted in 31 worksforrevenue of Rs.15,75,290/- (RupeesFifteen Lakh Seventy Five Thousand TwoHundred and Ninety)and the details of works are appended.

E.2 Infrastructure

The important equipments available in the laboratory are

i) ***Hydrometer test with accessories***

ii) ***Atterberg's limit devices***

iii) ***Direct Shear apparatus***

iv) Automatic Compactor

v) Light and Heavy compaction testing apparatus

vi) Laboratory CBR test apparatus

vii) Digital soil cone penetrometer

viii) Constant head permeability test apparatus

ix) Variable head permeability test apparatus

x) Tri-axial Shear Apparatus

xi) Unconfined Compression Test Apparatus

xii) Consolidation Apparatus

xiii) Sample extruder

Modernizing the lab will come true with the addition of modern Instruments. This lab is equipped with Seismograph and is used to obtain thickness of soil layer by seismic refraction method.Seismograph is also used for Seismic tomography to determine compactness in dams.

Fig 1. Unconfined Compression Test Apparatus **Fig 2. Extruder**

Fig4. Consolidation apparatus **Fig 3. Hydrometer Analysis**

Fig 5. Direct Shear Apparatus

E.3 ConductingSeismic Refraction Survey UsingEngineering Seismograph

Seismic refraction survey isa reconnaissance survey used to determine wave propagation velocities through various soil layers in the field and to obtain the thickness of each layer. This method is based on the fact that seismic waves have different velocities in different types of soils (or rock). In this method, seismic waves are produced by mechanical blow with a sledge hammer at ground surface. These waves travel deep into the ground and get refracted at the interface of two different materials and to the ground surface. The time of arrival of these waves at different locations on the ground surface are recorded by geophones, which pick up the refracted waves. The geophones convert the ground vibrations into electrical impulses and transmit them to a recording apparatus (seismograph). It is a widely used method for the determination of bedrock depth.

Seismic refraction survey was conducted on a study basis using Engineering Seismograph at following places during 2019-20.

1. **Mullasseri Church**
2. **Enamakkal**
3. **Government Engineering College, Thrissur campus**
4. **Poomala**

It was observed that the results obtained in seismic refraction survey atMullasseri Church and Govt. Engineering College, Thrissurcampusis matching with the actual borelogchart.Resultswerenot obtained at Poomala due to the presence of loose soil fill formed due to landslide on the surface of the earth and lack of enough space available for placing the geophones.

Bed rock depth is not obtained at Enamakkal due to lack of availability of space for placing 24 geophones in a linear array. Space was only available for placing 12 geophones in a linear array at the same location.The depth of penetration in a seismic refraction survey is approximately 1/3 to 1/5thof the length of the geophone spread.As per the borelog chart, bed rock is located at deeper depth (>35 m) at Enamakkal. Due to these reasons bed rock depth is not obtained at Enamakkal in Seismic Refraction Survey.

Fig 6.Engineering seismograph

Fig 7.Seismic refraction survey at Enamakkal

E.3.1 Seismic Refraction Survey At Mullassery Church

Introduction

A seismic refraction survey (Seismography Survey) was conducted on study basis at the premises of the Mullassseri Church on 19/12/2019. The purpose of the seismic refraction survey was to determine the depth of bedrock and thickness of different layers of soil. The P-wave seismic refraction technique was the primary technique used during this investigation.

EQUIPMENT

1. **X610S 24 bit Seismograph**
2. **Vertical geophones – 12 nos**
3. **Sledge Hammer**
4. **Battery**
5. **Plate for seismic energization**
6. **Cable/array**
7. **Starter geophone**

8. Starter extension cable 220m

Fig 8. Apparatus used for Seismic Refraction Survey

Picture 1. X610-S Control panel

The following elements can be found on the panel of the instruments:

1) TFT LCD 12,1" colour display for an immediate efficiency and a high visibility in any condition of usage;

2) Main switch with power supply spy. This led will be always switched on while the instrument's functioning.

4) Indicator for the hard disk functioning.

5) VGA connector for for (an eventual) external monitor

6) RJ45 connector for eventually connecting the instrument to a LAN network or for exchanging data

7) USB port to connect external devices and particularly a data back-up device;

8) Cap for protective fuse (5x20 format; 3,15A Fast type); unscrew to replace it.

9) 12V VEAM connector for the power supply of the instrument.

Fig 9. Parts of X610-S Seismograph

Methodology

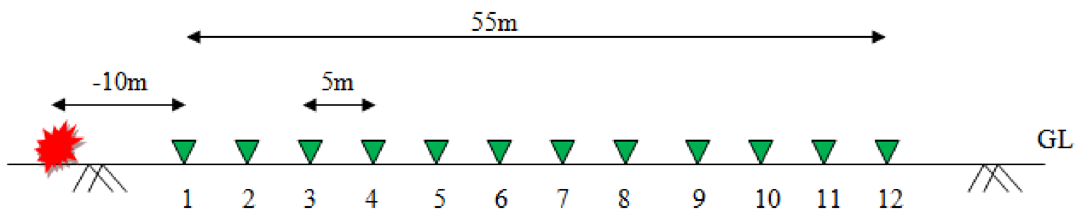
Seismic refraction survey is used to determine wave propagation velocities through various soil layers in the field and to obtain the thickness of each layer. It is a widely used method for the determination of bedrock depth. This method is based on the fact that seismic waves have different velocities in different types of soils (or rock).

In this method, seismic waves are produced by mechanical blow with a sledge hammeron a metallic plate at the ground surface. The seismic waves propagate into the subsurface at a velocity dependent upon the elastic properties of the material through which they travel. When the waves reach an interface where the density or velocity changes significantly, a portion of the energy is reflected back to the surface and the remainder is transmitted into the lower layer. Where the velocity of the lower layer is higher than that of the upper layer, a portion of the energy is also critically refracted along the interface. Critically refracted waves travel along the interface at the velocity of the lower layer and continually refract energy back to the surface. Receivers (geophones) laid out in linear array on the surface, record the incoming refracted and reflected waves. The seismic refraction method involves analysis of the travel times of the first energy to arrive at the geophones. These first arrivals are from either the direct wave (at geophones close to the source), or critically refracted waves (at geophones further from the source).

Seismic Refraction Survey was conducted using 12 Nos. of geophones spaced at 5m aligned in a linear array. 3 shot points were used for the survey; 1 direct, 1 indirect and 1 central.

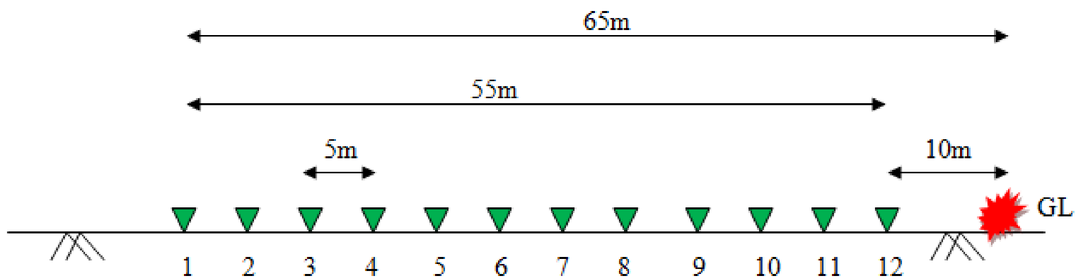
Shot points used: *-10 m, 65 m and 27.5 m*

- ***Direct Shot***



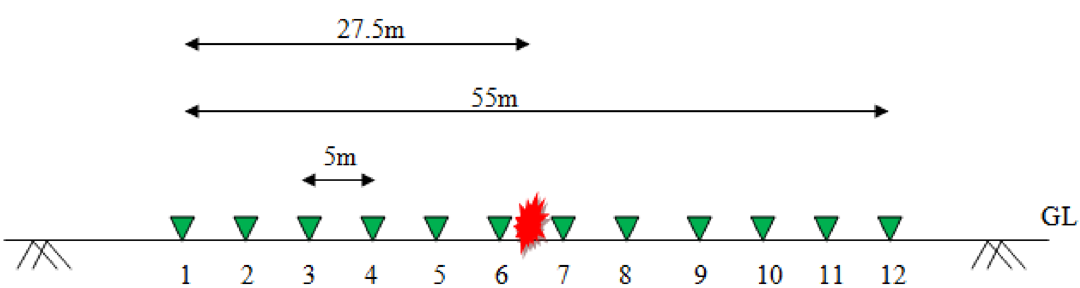
Shot Distance: -10 m

- ***Indirect Shot***



Shot Distance: 65 m

- ***Central Shot***



Shot Distance: 27.5 m

Fig.10 Shot position and Geophone placement

Data Processing

Seismic refraction data wereanalysed using PS Lab software.PS Lab allows simple processing of seismic data in SEG2 format. Through a guided path, program enables to get a detailed report of the survey, accompanied by graphics and tables, starting from field data.

For surface seismic analysis, identification of depth of each layer is based on generalized reciprocal method (GRM), which requires a minimum of three energizations along the array and calculates depth below each geophone and average velocity of compression waves (P Wave) through seismic layers. When first arrival times identification has been performed, directly on seismograms with different graphic aids or with manual entry in a table, the analysis of travel time graphs is made simply by an intuitive approach which provides attribution of observed times to each refractors by means of a simple mouse-click. Calculation of Vp (P wave velocity)velocity is based on interval method (i.e.,based on measurements of the time interval between initiation of a seismic wave and its arrival at detectors). Program calculates velocity for each layer by analysis of travel time.

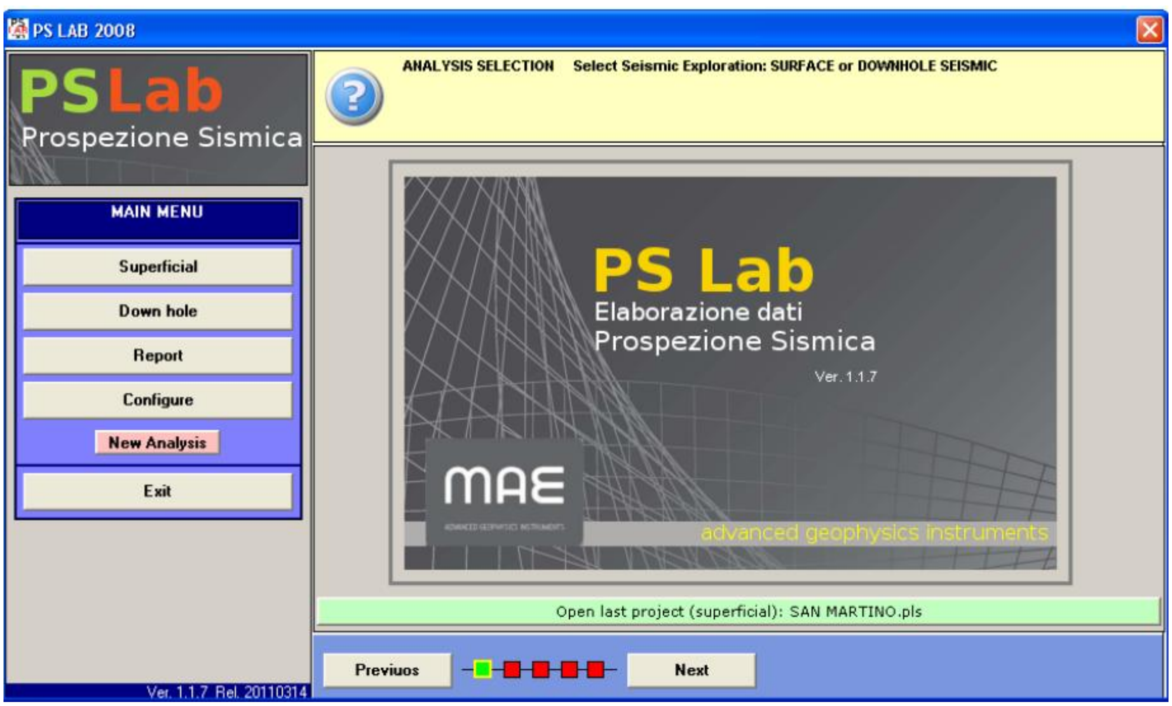


Fig 11. PS Lab software interface

Result&Interpretation

Result obtained after analyzing the data in PS Lab software is given below. P Wave velocity of sub surface strata at the premises of Mullassery Church is shown in Fig 12.

Materials with three distinct ranges in seismic velocities were detected in the seismic survey. The uppermost and intermediate layer, with P Wave velocities ranging from358.6m/s to 1579.25m/s, is interpreted to as soil layer. The deepest layer is interpreted to be competent bedrock, and exhibits average velocityof 3226.1m/s.Bedrock depths determined in this survey vary between 19.17 and 23.96 meter below ground surface.

Borehole data received from the same site were used to validate the seismic refraction survey results. Borehole was located approximately 20m away from the site on which seismic refraction survey were conducted. Borelog chart is given in Fig.13.

While analyzingborelog chart, it is observed that SPT ‘N’ value is increasing after 6m. It shows the presence of comparable hard stratum beyond 6m.In seismic refraction survey also 2nd layer with average velocity of 1579.25m/s is observed after 5.04m - 6.02m to 19.17m - 23.96m. According to borelog chart, medium hardrock is available beyond 20m depth. Bedrock depth determined from Seismic Refraction Survey varies between 19.17m to 23.96m. Hence it is clear that results of seismic refraction survey at the premises of Mullasseri Church are matching with the borelog chart.

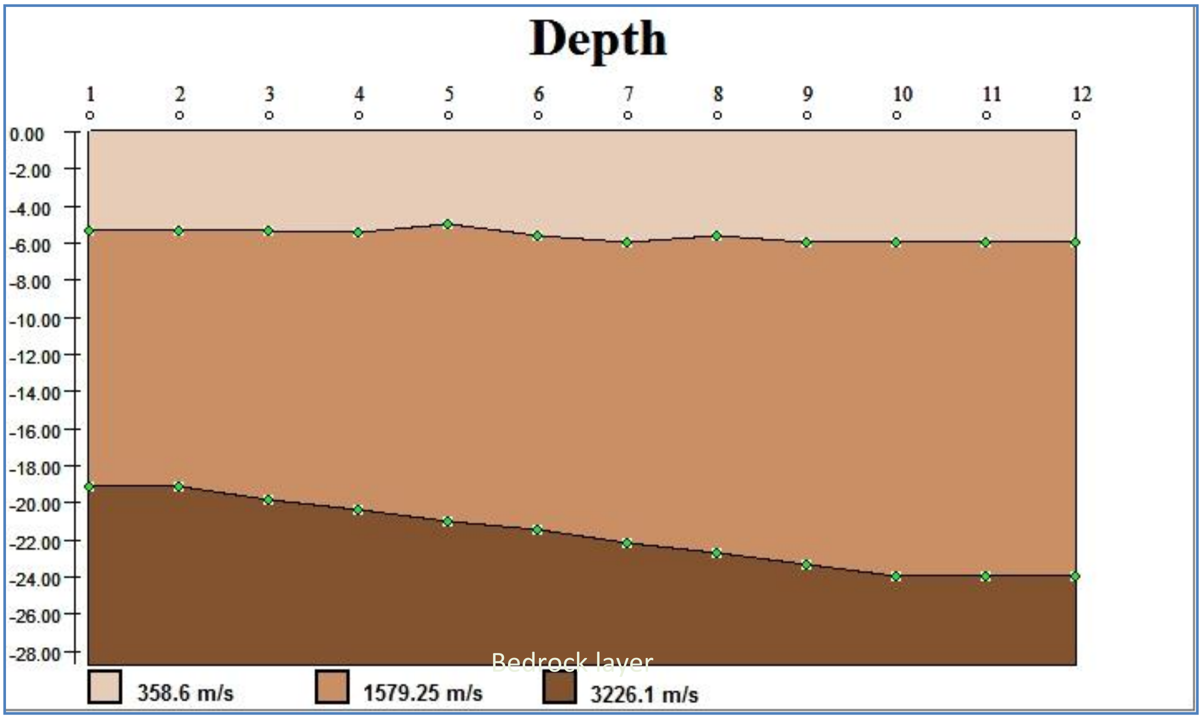


Fig 12. Seismic refraction survey results of premises of Mullassery Church

CLIENT: MOUNT CARMEL CHURCH
PROJECT: PROPOSED CHURCH
SITE: MULLASSERY, THRISSUR

BORE HOLE NO. : **BH-II** | Date of start:30/10/2019
Date of completion:31/10/2019
TYPE OF BORING: Rotary Drilling | Ground water table:1.00 m below GL

Description of soil	Thickness of layer m	Depth in m below GL	Bore log	Standard Penetration Test depth (m)	15 cm	30 cm	45 cm	N Value	Graph of 'N' value (10, 20, 30, 40, 50, ≥50)	Remarks
Filling	1.60	1.60		1.00	2	1	1	2		
Lateritic Clayey Sand with Gravel	2.40	4.00		2.00	1	2	1	3		
				3.00	1	1	0	1		
Lateritic Clay with Sand	1.00	5.00		4.00	4	3	5	8		
Lateritic Clayey Sand	0.80	5.80		5.00	6	7	9	16		
Clayey Sand	1.20	7.00		6.00	4	2	3	5		
Lateritic Pebbles	0.40	7.40								
Lateritic Clayey Sand with Gravel	1.60	9.00		7.50	50	-	-	>50		32cm balance
Lateritic Clay with Sand	11.00	20.00		9.00	11	6	10	16		
				10.50	11	17	20	37		
				12.00	13	19	23	42		
				13.50	7	9	12	21		
				15.00	8	10	14	24		
				18.00	6	13	20	33		
Medium Hard Rock	1.00	21.00		20.00						Recovery-15% RQD-Nil

Bore hole terminated at 21.00m depth

Fig 13.Borelog chart of the premises of Mullassery Church

APPENDIX

Place: Mullasseri Church

Date and Time: 19/12/2019

Geophone	Distance (mt)	Height (mt)
1	0.00	0.00
2	5.00	0.00
3	10.00	0.00
4	15.00	0.00
5	20.00	0.00
6	25.00	0.00
7	30.00	0.00
8	35.00	0.00
9	40.00	0.00
10	45.00	0.00
11	50.00	0.00
12	55.00	0.00

- FIRST ARRIVAL -

27.50 mt [SX]	27.50 mt [DX]	-10.00 mt	65.00 mt
52.87 ms		28.87 ms	54.87 ms
48.07 ms		43.53 ms	54.20 ms
44.47 ms		47.80 ms	53.40 ms
27.27 ms		51.53 ms	52.60 ms
18.60 ms		57.13 ms	51.40 ms
11.27 ms		60.20 ms	49.53 ms
	11.93 ms	61.00 ms	46.73 ms

	23.27 ms	67.13 ms	44.20 ms
	33.53 ms	71.80 ms	41.53 ms
	41.93 ms	73.40 ms	37.80 ms
	44.73 ms	87.27 ms	35.00 ms
	48.33 ms	89.53 ms	26.73 ms

- DEPTH LAYERS -

Geophones	2° layer	3° layer
1	-5.36 mt	-19.17 mt
2	-5.36 mt	-19.17 mt
3	-5.36 mt	-19.84 mt
4	-5.43 mt	-20.46 mt
5	-5.04 mt	-21.07 mt
6	-5.65 mt	-21.52 mt
7	-5.97 mt	-22.19 mt
8	-5.69 mt	-22.78 mt
9	-6.02 mt	-23.37 mt
10	-6.02 mt	-23.96 mt
11	-6.02 mt	-23.96 mt
12	-6.02 mt	-23.96 mt

- LAYERS SPEED -

Layer speed # 1	**358.60 m/s**
Layer speed # 2	**1579.25 m/s**
Layer speed # 3	**3226.10 m/s**

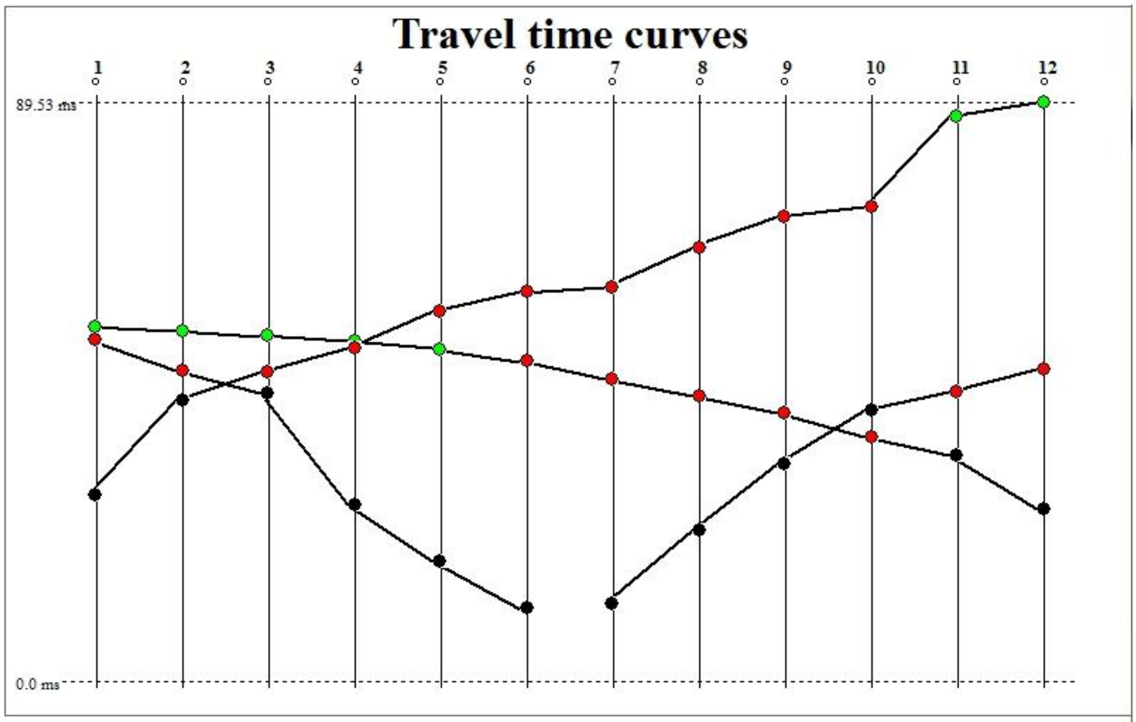


Fig.14 Travel time curves

E.3.2 Seismic Refraction Survey At Government Engineering College (GEC) Thrissur College Campus

Introduction

A seismic refraction survey (Seismography Survey) was conducted on study basisat Govt. Engineering College,Thrissur campus on 25/01/2020.The purpose of the seismic refraction survey was to determine the depth of bedrock and thickness of different layers of soil.

Result&Interpretation

Result obtained after analyzing the data in PS Lab software is given below. P Wave velocity of sub surface strata at GEC Thrissur campus is shown in Fig 5.

Materials with two distinct ranges in seismic velocities were detected in the seismic survey. The uppermost layer, with P Wave velocities ranging from 582.65m/s, is interpreted to as soil layer. The 2nd layer is interpreted to be hard strata, and exhibits average velocity of 2734.50m/s.

Borehole data received from the same site was used to validate the seismic refraction survey results. Borelog chart of proposed computer science building at GEC, Thrissur was used for the validation purpose. Seismic refraction survey was conducted near to this borehole. Borelog chart is given in Fig.6.

While analyzing borelog chart, it is observed that hard strata is available beyond 7.6m from the ground level. In seismic refraction survey also 2nd layer with average velocity of 2734.50m/s is observed after 7.09m – 8.87m, which indicates the presence of hard stratum. Hence results of seismic refraction survey at GEC, Thrissur campus are matching with the borelog chart.

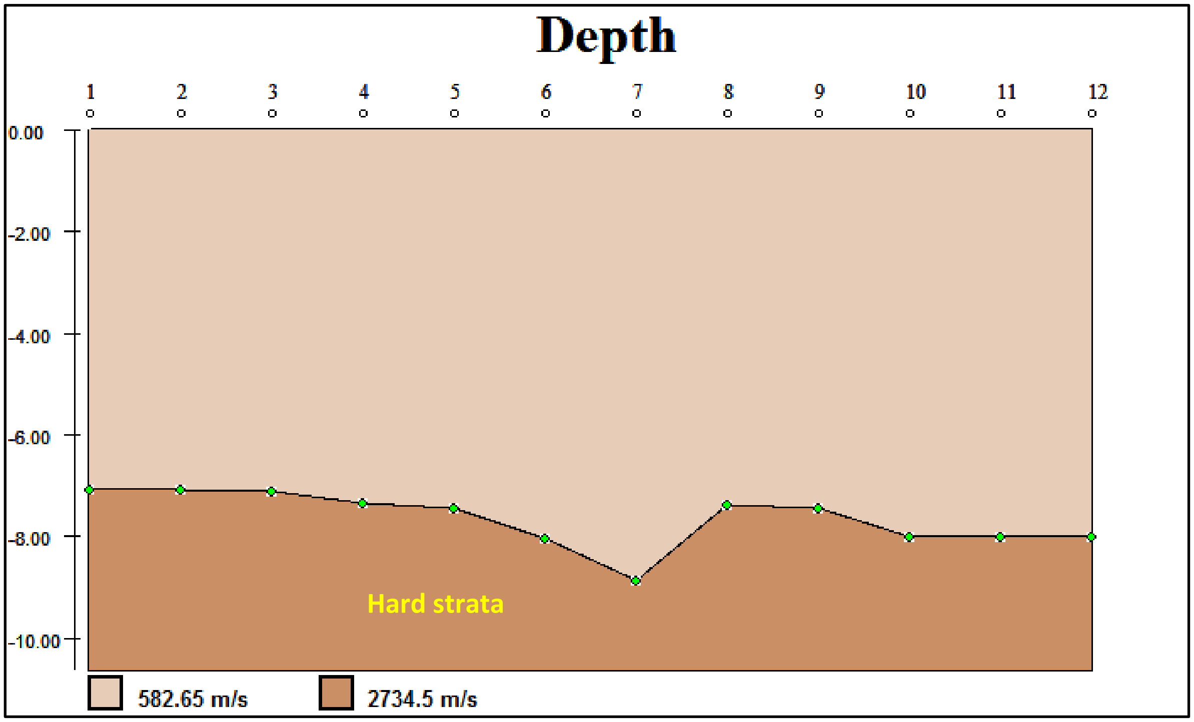


Fig.15 Seismic refraction survey results at GEC Thrissur campus

Fig 16. Seismic refraction survey at GEC Thrissur Campus

Type of Boring: Rotary drilling

BORE LOG CHART AND DATA SHEEL NO:1

Depth Below GL. m	Soil Profile	Visual description of Soil	Thickness of layer m	Date of sampling	Standard penetration test					Remarks
					Depth Below GL. m	15	30	45	N-Value	
0.00		Filled Gravel	2.00	23.11.17	1.50	2	2	4	6	
2.00		Laterite	5.60		2.50	13	15	19	34	
					3.50	15	19	21	40	
					5.00	13	14	17	31	
					7.00	4	8	>50	>50	Bal. 5cm
7.60		Hard strata (End of BH)			7.60	Rebound				

Client: Principal, Government Engineering College Thrissur.

Project: Proposed Computer science & Engineering Building

Bore Hole No: I

Reduced level of Ground: 0.50m. Below existing Computer science & Engineering Building Ground Level

Position of Water Table: Nil

INVESTIGATOR/CONSULTANT

Fig 17.Borelog chart of the proposed computer science building at GEC Thrissur

APPENDIX

Place: Govt. Engineering College, Thrissur Campus

Date and Time: 25/01/2020

Geophone	Distance (mt)	Height (mt)
1	0.00	0.00
2	5.00	0.00
3	10.00	0.00
4	15.00	0.00

5	20.00	0.00
6	25.00	0.00
7	30.00	0.00
8	35.00	0.00
9	40.00	0.00
10	45.00	0.00
11	50.00	0.00
12	55.00	0.00

- FIRST ARRIVAL -

-10.00 mt	65.00 mt	27.50 mt [SX]	27.50 mt [DX]
20.47 ms	43.27 ms	26.33 ms	
26.07 ms	41.40 ms	24.07 ms	
33.67 ms	40.07 ms	20.33 ms	
37.00 ms	38.47 ms	16.07 ms	
42.33 ms	39.13 ms	14.87 ms	
43.80 ms	37.13 ms	7.53 ms	
44.87 ms	31.80 ms		11.00 ms
50.07 ms	30.47 ms		18.07 ms
50.47 ms	29.40 ms		21.27 ms
51.80 ms	24.20 ms		24.73 ms
54.47 ms	20.20 ms		28.87 ms
55.80 ms	16.47 ms		31.13 ms

- DEPTH LAYERS -

Geophones	2° layer
1	-7.09 mt

2	-7.09 mt
3	-7.14 mt
4	-7.35 mt
5	-7.45 mt
6	-8.04 mt
7	-8.87 mt
8	-7.40 mt
9	-7.45 mt
10	-8.03 mt
11	-8.03 mt
12	-8.03 mt

- LAYERS SPEED -

Layer speed # 1	**582.65** m/s
Layer speed # 2	**2734.50** m/s

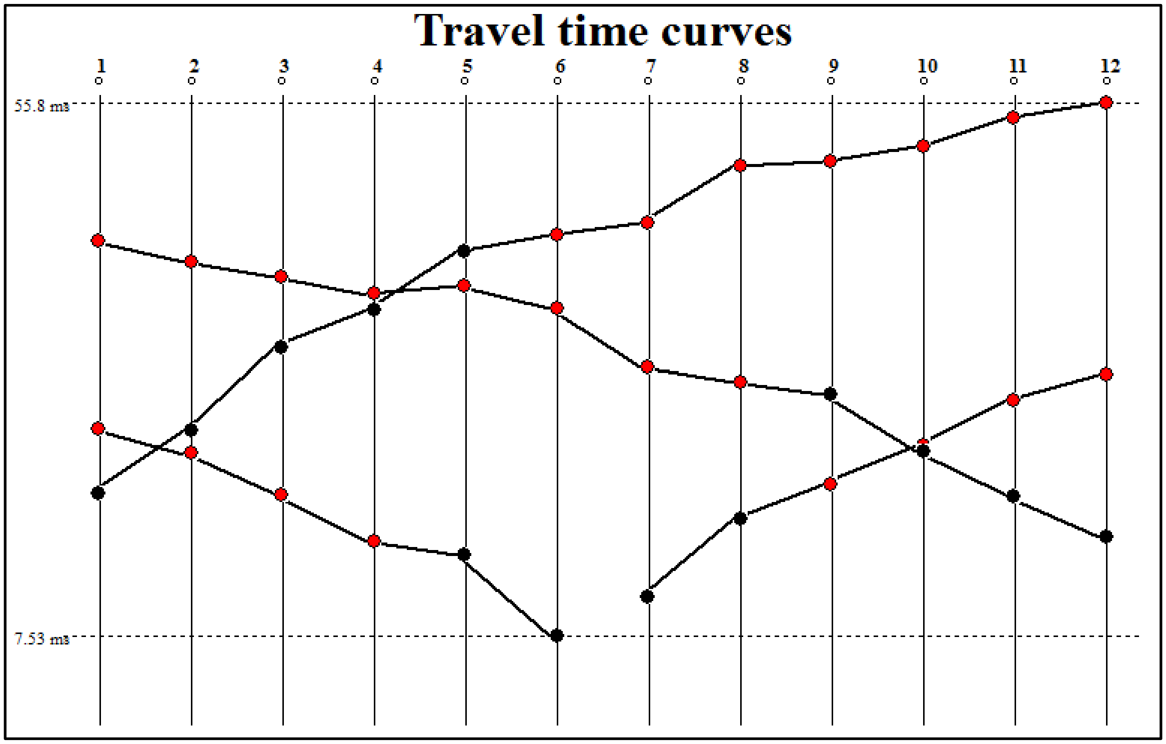


Fig.18 Travel time curves

E.4 Conducting Tomographic Survey at Peechi Dam

The ageing and degradation of dam structures is an inevitable problem and its consequences on the safety of the structure are important. Seismic tomography is typically used to determine compactness in dams. Seismic tomography surveys are generally conducted across vertical upstream-downstream cross sections. Seismic signals are generated with a sledge hammer, by hitting directly on the dam body. Hydrophones are arrayed in vertical on upstream side of the Dam and shot position fixed on downstream face of the Dam. Typically, tomography images are analysed to look at the velocity changes within the masonry or concrete. Areas with lower velocity correspond to weaker, less dense concrete, while those with higher velocities are considered to be sound concrete. The results also can show areas with cracking damage or other discontinuities.

Seismic tomography survey was conducted at Peechi Dam on a study basis during March, 2020. Tomography survey was conducted at 8 vertical upstream-downstream cross sections of Peechi Dam. Analysis part is to be done.

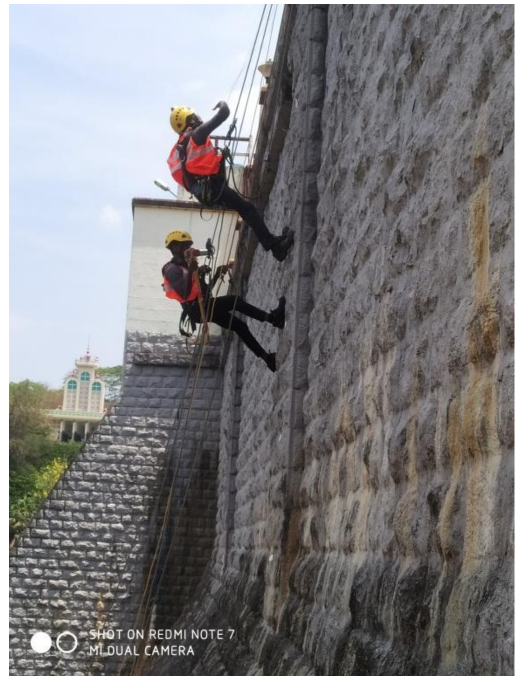


Fig 19. Tomography study at Peechi Dam

Fig 20. Tomography study at Peechi Dam

E.5 Proficiency Testing for the Process of NABL Accreditation

Proficiency Testing (PT) is the evaluations of participant performance against pre-established criteria by means of inter laboratory comparisons.It is an essential element of quality assurance. Proficiency testing provides the means by which external customers can compare competence in carrying out specific tests.Proficiency testing is an independent and unbiased assessment of the performance of all aspects of the laboratory, both human and hardware.Itprovides additional confidence to laboratory clients.This is an essential part of achieving and maintaining NABL accreditation to IS/ISO/IEC 17025: 2017.

This lab was participated in the Proficiency testing for the following tests.

- ***Liquid Limit***
- ***Plastic Limit***
- ***Light Compaction Test***

Proficiency testing was conducted by "Green Economy Initiatives Private Limited". Satisfactory results were obtained for all the 3 tests mentioned above, with lowest deviation from mean value among 11 participated labs. The certificate obtained for participating in proficiency testing is shown below.

Program Code–19BMM03P3P2

CERTIFICATE OF PARTICIPATION

Certificate No. PC-1005

This certificate confirms that **Soil Mechanics & Foundations Division, Kerala Engineering Research Institute, Peechi, Thrissur, Kerala, India.** participated in proficiency testing programme in mechanical discipline for product Building Material- Soil**.** The laboratory code and summary of laboratory performance in different parameters covered in program is given below:

Program Code: 19BMM03P3P2
Program Duration: 30.10.19 – 25.1.20

The detailed report including interpretation of results and overall performance of all participating laboratories is enclosed and be read along. This certificate is only issued for ease of reference to laboratory's performance.

					Light Compaction Test (Standard)			
Lab Code	**Liquid Limit$**		**Plastic Limit$**		**Dry Density$ gm/mL**		**Optimum Moisture Content$ %**	
	Lab result	**Z'score**	**Lab result**	**Z'score**	**Lab result**	**Z score**	**Lab result**	**Z'score**
19BMM03P2/P3-10	27.0	-0.03	19.0	0.03	1.84	0.00	13.9	-0.22

$	Participant performance for this analyte has been assessed using a Z'score, rather than a Z score, in order to account for the measurement uncertainty of the assigned value which is not negligible when compared to the standard deviation for proficiency assessment (SDPA or σ_{pt})

रणदीप सिंह

Dr. Randeep Singh Saini
PT Coordinator
M: 8872061900 **Email:** greeneconomyipl@gmail.com

Green Economy Initiatives Private Limited CIN: U74900PB2013PTC038026
Proficiency Testing Provider P-0015
215 Silver City (Main) | Ambala Chandigarh Expressway (NH-22) | Zirakpur | District Mohali, 140603 Punjab | INDIA

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INTERPRETATION OF **Z / Z'**SCORES

For quantitative examinations, the following interpretation is given to results

Z / Z'SCORES	**Interpretation**	**Coding**
$\|Z/ Z'\| \leq \pm 2.00$	Satisfactory result	Normal Black
$\pm 2.00 < \|Z/ Z'\| < \pm 3.00$	Questionable result	**Bold Black**
$\|Z/ Z'\| \geq \pm 3.00$	Unsatisfactory result	Bold Red

E.6 Other Activities

E.6.1 Field work conducted

- ***SiteVisitwas carried out along with Instrumentation division for the investigation ofthe breached portion of Shanmugam canal bund road in PoomangalamPanchayath.***

- ***Site visit were carried out along with Instrumentation divisiontoGulikadavu-Chitturroad which is damaged due to landslide during flood occurred in 2019.***

- ***Er. Miny T M, Deputy Director and Er. JoyalScaria, Assistant Directorwere participated in the flood damage assessment duty entrusted by the District Collector, Thrissur.***

E.6.2 Trainings Attended

- Er. JoyalScaria, Assistant Director has attended the induction training course on "Irrigation Water Management" organised by Centre for Water Resources Development and Management (CWRDM), Kozhikode held during 18-30 November, 2019.

- Er. JoyalScaria, Assistant Director has attended 4 day training programme on "Laboratory Quality Management System & Internal Audit as per IS/ISO/IEC 17025:2017" held during 17-20 February, 2020 at Bangalore conducted by National Institute of Training for Standardization, Bureau of Indian Standards (BIS).

E.6.3 Training Conducted

This division was a part of the training programme on “General Practices in Soil Investigation andBasic Awareness on Geotechnical and Construction Materials Laboratory Testing” held during 13 - 15 February, 2020 for Assistant Engineers and Assistant Executive Engineers of the departmentconducted by Publications Wing, KERI, Peechi.

Fig 21.Snapshots taken during training

E.6.4 Internship programmes

Internship trainings were given to students of several engineering colleges as part of their curriculum

Fig 22. Internship training to engineering college students

E.6.5 Infrastructure work

- Worknamed "Upgradation of existing infrastructure for acquiring NABL accreditation for soil lab" is completed for an amount of Rs.2,84,251/-
- An amount of Rs.7.75 lakhs was sanctioned in the year 2019-20 for the updating old electrical wiring of the Lab and tendered the work.

E.6.6 Preparation of Laboratory Manual

Soil Mechanics Laboratory Manual has been prepared in 2019-20 which provides a foundation for the lab's quality assurance program. This manual will be very useful for the newcomers.

E.7 Laboratory Investigation

Soil samples analysis for undisturbed and disturbed samples were tested during the year is given in Appendix IV.

F. INSTRUMENTATION DIVISION

F.1 Introduction

Instrumentation Division acts as the mobile unit of Soil Mechanics Division and conducts various field tests. The foundation is the lowest part of a structure. It transmits the load to the soil below.The extent of exploration depends on the importance of the structure, the complexity of the soil conditions and the budget available for exploration. A detail soil exploration programme involves deep boring, field tests and laboratory tests for determination of different properties of soils required for the design of any structure.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.

Bore Hole Drilling – Making Bore holes is commonly used method for field investigations and they are executed by various devices ranging from simple hand operated augers to drilling machines.

1) Instrumentation division is in possession of two rotary type clayx type drilling machines. These machines are used for drilling in soil, soft rock and hard rocks for a depth of 50m to 60m. SPT Tests are also conducted during the process of drilling. Disturbed and undisturbed samples are also collected during the course of drilling. Drilling in rocks is carried out by using diamond core bit. The samples collected are

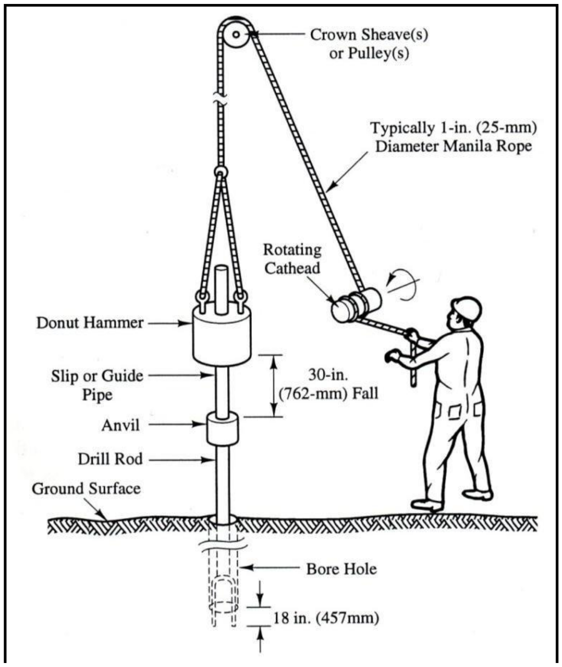
transferred to Soil Mechanics &Foundations Division for carrying out various tests in soil for finding the engineering properties.

2) Insitu vane shear test apparatus – In-situ vane shear test apparatus instrument is used for conducting in-situ vane shear tests to determine the shear characteristics of the soil.

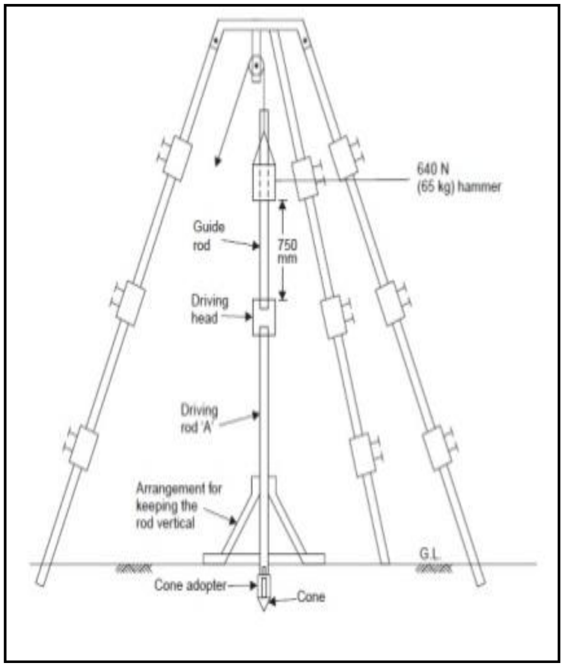
3) Permeability tests – Instrumentation division has also in possession of screw pumps and other related accessories for conducting field permeability tests of hard rock strata. Permeability test has not yet been carried out by this division.

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.

- **Standard Penetration Test.**
- **Dynamic Cone Penetration Test.**
- **Collection of disturbed and undisturbed soil samples by hand auger and machine boring.**
- **In situ VaneShear test**



Standard Penetration Test



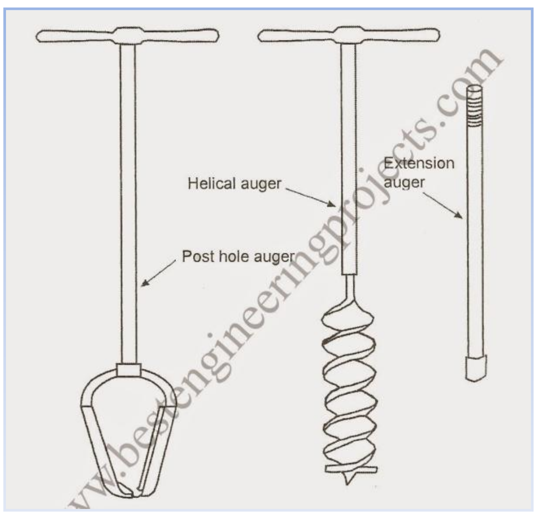
Dynamic Cone Penetration Test

F.2. Infrastructure

The important equipments available in the Division are

- Equipments for hand augering.
- In situ Vane shear test apparatus
- Diesel boring plant.- 2 No.s
- Gravity corer sample collector unit


Vane Shear Apparatus   Gravity Core Sampler



Hand Auger   Diesel Boring Plant

F.3 Activities of the division during the current year

This Division took part in the following work:

F.3.1 Construction of 2 Nos. of check Dam cum Foot - bridge across Kalpathy River in ward No:1 at Kunnumpuram in Palakkad Muncipality

The above investigation work has been carried outas per the letter No.D1-Kalpathy Checkdam/2018-19 dated:4/07/2019 of the Executive Engineer, Minor Irrigation Division, Palakkad for the construction of2 Nos. check dam cum Foot-bridge across Kalpathy River. 3Nos. of Bore holes were taken.The investigation work was carried out from 09/12/2019 to 14/12/2019. But the work was temporarily stopped due to issues related to the location of structure. The issue was not resolved yet.AS and TSwas for an amount of Rs.7,40,000/- and the expenditure amount for the work was Rs.84,108/- under the head of account 8443-00-108-00-00-00-V(PW Deposit).

F.3.2 Soil Investigation for the Construction of Check Dam across Thoothapuzha at Mundorssikkadavu in SreekrishnapuramGrama Panchayat of Palakkad District

The above investigation work was carried out as per the letter No.D3/INV/2019 Dated:15/07/2019 of the Executive Engineer,MI division Palakkad.16Nos. of Bore holes (including 5 boreholes which failed due to site conditions) were explored.The Investigation work was carried out from 18/12/2019to10/01/2020.Total amount expended for the works is Rs.2,83,557/-.FS, AS&TS was for an amount of Rs.4,27,000/- under the head of account 4700-80-005-99-02-00-V (INVESTIGATION OF MAJOR IRRIGATION SCHEMES).

F.3.3 Soil Investigation for the Construction of Check Dam across Gayatri Puzha at AnapparaChundekkad in Kavassery Panchayat in Palakkad District

The above works was carried for the construction of check dam across Gayatri Puzha at Anappara Chundekkad in Kavassery Panchayat, Palakkad District.Total number of bore holes taken is eleven (including 2 boreholes which failed due to site conditions). The Investigation work was carried out from 1/4/2020 to 7/02/2020.Total amount expended for the works is Rs.3,00,000/-. FS,ASand TS was for an amount of Rs.3,15,000/-, under the head of account 4700-80-005-99-02-00-V (INVESTIGATION OF MAJOR IRRIGATION SCHEMES).

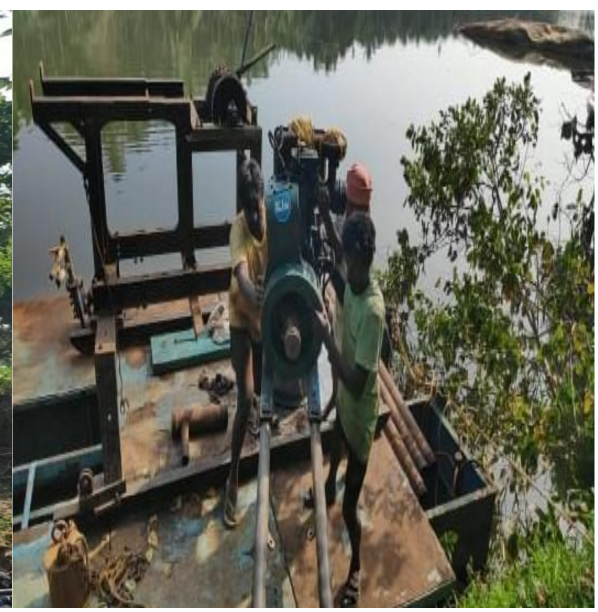
F.3.4 Soil Investigation for the Construction of New Check Dam across Thoothapuzha in VilayoorGrama Panchayat in Palakkad District

The proposal is for the Investigation work of check dam across Thoothapuzha at Thonikadavu in Vilayoor Panchayath. 14 bore holes were drilled during the period from 25/01/2020 to 24/02/2020.Total Amount Expended is Rs.3,27,505/-.FS, AS & TS was for an amount of Rs.4,95,000/-under the head of account 4700-80-005-99-02-00-V (INVESTIGATION OF MAJOR IRRIGATION SCHEMES).

F.3.5 Soil Investigation of various works for Irrigation Department - Investigation works for the breached portion of Karapuzha – Padinjareveedu Branch canal chainage at 1110 m to 1210 m, Wayanad District

The above investigation work was carried out as per the letter of No.WP3-677/2017 dated: 31/05/2019 the Chief Engineer, Irrigation, Projects 1,Kozhikode.The above investigation work has been takenfor rectifying breached portion of Padinjareveedu Branch canal.The total number of bore hole drilled is11Nos.Investigation work was carried out from 13/02/20 to 17/03/2020. AS and TS was for an amount of Rs.8,00,000/-. Amount expended for this work is Rs.4,68,760/- under the Head of A/C – 4701- 80- 800-99-00-00-V Development of KERI stage II.

Boring works in Kalpathy



Dismantling Instrument at Sreekrishnapuram

Boring works in Sreekrishnapuram

Boring works in Gayatripuzha

Core of 1.58m length recieved in Gayatripuzha

Boring works in Gayatripuzha


Boring works in Karapuzha **Retreiving jammed drilling rod in Karapuzha**

Publication wing

Deputy Director	Er. Saji Samuel
Assistant Director	Er. Sreedev M.S.(F.A.C.)

G. PUBLICATIONS WING

G.1 Introduction

Publications Wingis acting as the information bureau of the Kerala Engineering Research institute. This wing provides necessary technical information to all other divisions through its technical library containing around 10,000 (ten thousand) books and a number of latest periodicals.This wing conducts seminars and training programmes for the benefit of staff of the Institute. Also, the wing conducts Trainings and Refresher courses for the staff of the Irrigation Department. Publications Division was deployedwith effect from 31/01/2017 and the activities are now being taken up under Instrumentation Division.

G.2 Activities of the Wing

During the financial year 2019-20 the main areas of work attended by this wing are:

- Maintenance and development of Library.
- Editing and publishing of Annual Report 2018-19.
- Conducting Seminars for the benefit of the technical hands and staff in the institute.
- Conducting training programme for the Engineers and technical staff of the department.
- Routine works of Publications Wing.

G.3 Library Service

This Wing 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.Facilities are also 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 Periodicals

A total of 7 numbers of Indian periodicals were subscribed by this Wing. The following journals were purchased by subscription during the year.

G.3.1.1. Indian Periodicals

1. Indian Concrete Journal
2. Electronics for You
3. Indian Journal of Power & River Valley Development
4. Civil Engineering and Construction Review
5. Master builder
6. Down to earth

G.4 Publication of Annual reports

Annual Reports for 2018-19 was published and copies were sent to important institutions and personnel.

G.5 Seminar Programme

Sl. No.	Title of paper	Name of speaker	Date
1	An interactive session on future forecast for Irrigation Dept.	Er. D. Biju Executive Engineer Kuttanad Development Project	24.06.2019
2	Subsurface investigation	Er. Saju varghese, Assistant Director KERI, Peechi	02.07.2019
3	Promoting KERI to International cum Research Centre	Prof. Narayanan Kutty	08.07.2019
5	Design of pipe networks (both with fluids under gravity and under pressure) using free software Epanet	Shaiju P Thadathil Executive Engineer KWA	29.08.2019
7	മലയാളംഭരണഭാഷപരിശീലനപരിപാടി	Ajayakumar V N L D Typist SM&F Division, KERI	04.09.2019
8	Seminar Program - Concrete mix design as per IS 10262-2019 and Geopolymer concrete	Dr. N Ganeshan Former Professor NIT Kozhikkode	29.09.2019
9	Workshop on PRICE and E-tendering	Vivek PM 2nd Grade Overseer CM & FE Division	30.09.2019
11	The Kerala Service Rules	Shehna N A Divisional Accountant	25.10.2019
12	Introduction to HEC - HMS - A hydraulic modelling software and its application in water resources management	Sufeera O B Assistant Director Coastal Engg. Division	13.11.2019

		KERI	
13	Introduction to GIS and its application in water resource management	Remya MR Research Assistant CM Division, KERI	12.12.2019
14	Different methods for a accelerating the consolidation settlement	Joyal Scaria Assistant Director SM&F Division, KERI	16.01.2020

G.6 Enhancement of the Stature and Productivity of KERI

Honorable Minister of Water Resources, Sri. K. Krishnankutty visited KERI on 08/07/2019 and presided the meeting related to promoting KERI to International Training Cum Research Centre. Recommendations To Enhance The Stature And Productivity Of Kerala Engineering Research Institute were suggested by Prof. Narayanan Neithalath, Professor, School of Sustainable Engineering and Built Environment, Senior Sustainability Scientist, Arizona State University, U.S.A., along with Mr.Sudheer Padikkal, Executive Engineer of JWR Division, Palakkad, who were special guests of this meeting. A presentation in connection with this was held at Seminar hall of Publication Division on 08/07/19. All Engineers of KERI were present. Developmental plans were proposed in the meeting to elevate existing Kerala Engineering Research Institute to an International Training cum Research Centre. A follow up meeting presided by Mr.Sudheer Padikkal, Executive Engineer of JWR Division, Palakkad, was held at the Publication seminar hall on 02/08/2019 to discuss the same. A team from CWRDM constituted to study the proposal for enhancing the stature of KERI also visited on 19.08.2019.

G.7 Review Meeting by the Chief Engineer, IDRB

A review meeting was presided by Sri.K.A. Joshy, Chief Engineer, IDRB on 31/08/2019 to review the progress of the activities related to various wings under Director, KERI.

H TRAINING PROGRAMME CONDUCTED BY KERI

H.1 Training on "General Practices in Soil Investigation and Basic Awareness on Geotechnical and Construction Materials Laboratory Testing"

This 3-day training programme wasconducted at KERI on 13/02/2020–15/02/2020targeted for the Assistant Engineers and Assistant Executive Engineers of Irrigation Department. Theobjectives of this training were to provide a general idea of soil investigation proceduresand to introduce various laboratory tests that are conducted at KERI to assess thestrength of soil and construction materials.KERI seminar hall was the venue for the program and the accommodation for the candidates was arranged at the International Guest House of Kerala Forest Research Institute, Peechi.

The training program has both theoretical and practical sessions of the various laboratory activities conducted at KERI. Class on subsurface investigation was presented by Sri. Saju

Varghese, Assistant Engineer, PVIP. Er. Joyal Scaria, Assistant Director, Soil Mechanics and Foundations Division, KERI presented a lecture on the "Activities in Soil Mechanics lab". Class on Activities in Construction Materials lab and introduction to NDT was taken by Smt. Siji T.V., Assistant Director, Construction Material Division, KERI.

Even though we had planned to conduct more training programmes to departmental engineers, due to treasury regulations on fund disbursal, we could not conduct those as planned.



H.2 Details of Training Attended by KERI Officials during 2019-20

Sl. No.	Name	Designation & Office	Name of training Course	Date
1	Er. Joyal Scaria	Assistant Director, SM & F Division, KERI	Induction training course on "Irrigation Water Management" organised by Centre for Water Resources Development and Management (CWRDM), Kozhikode	18/11/2019-30/11/2019
2	Er. Joyal Scaria	Assistant Director, SM & F Division, KERI, Peechi.	Laboratory Quality Management System & Internal Audit as per IS/ISO/IEC 17025:2017 by National Institute of Training for Standardization, Bureau of Indian Standards (BIS).	17/02/2020-20/02/2020
3	Er. Siji T V	Assistant Director, CM Division, KERI, Peechi.		
4	Er. Nisha Antony	Assistant Director,Hydaulics Division, KERI, Peechi.	Workshop on Data Collection and Design of Coastal Protection Structures conducted at IMG Thiruvananthapuram.	24/02/2020-25/02/2020
5	Aravindakshan V	Assistant Executive Engineer, Quality Control Subdivision, Kannur.		
6	Madhu K P	Assistant Engineer, Quality Control Section, Kannur.		

7	Prema.C.K.	Joint Director, Coastal Engineering Field Studies, Thrissur.		
8	Ushakumari.B	Assistant Director, Coastal Engineering Field Studies, Thrissur		
9	Ajantha V D	Assistant Director Coastal Engineering Section, Chavakkad		
10	Er. Sufeera O B	Assistant Director,Coastal Engineering Division, KERI, Peechi.	Capacity Building Program for officials of Irrigation Department, KSEB and CWRDM - Development of Integrated Reservoir Operations Management for Pamba basin reservoirs	25/04/2019-09/05/2019
			National conference on policies and strategies for flood management: Kerala scenario	23/01/2020-24/01/2020
11	Er. Saji Samuel	Deputy Director, Instrumentation Division, KERI, Peechi.	Workshop on Data collection and design of coastal protection structures at IMG, Tvm	24/02/2020-25/02/2020
			Dam break analysis and engineering action plan at CWPRS, Pune	05/12/2019-06/12/2019
12	Sabarinath S	2nd Grade Draftsman, Coastal Engineering Division, KERI, Peechi.	Induction Training for overseers conducted by IMG, TVM	27.05.2019-01.06.2019
13	Jestina K Jose	2nd Grade Overseer, Irrigation Quality Control SubDivision, Thrissur		
14	Sudhakaran.T.S	Assistant Executive Engineer Quality Control Sub Division, Palakkad	Micro Irrigation, conducted by Field Studies Circle, Thrissur	30.08.2019
15	Girish Kumar K	Asst. Engineer, Quality Control Section , Kozhikode	Workshop on Data Collection and Design of Coastal Protection Structures	24/02/2020-25/02/2020
			Training on General Practices in Soil investigation & Basic awareness on Geotechnical and Construction Materials	13/02/2020-15/02/2020

			Laboratory testing at KERI Peechi, Thrissur.	
16	Rajeev B	Asst. Exe. Engineer, Quality Control Subdivision, Kozhikode	Workshop on Data Collection and Design of Coastal Protection Structures	24/02/2020-25/02/2020
			Training on General Practices in Soil investigation & Basic awareness on Geotechnical and Construction Materials Laboratory testing at KERI Peechi, Thrissur.	13/02/2020-15/02/2020
17	Jestina K Jose	2nd Grade Overseer, Irrigation Quality Control Sub Division, Thrissur	Training Conducted by KERI, Peechi	3/7/2019
18	Sreeja K R	3rd Grade Overseer, Irrigation Quality Control Section , Thrissur		
19	Abdul Salam O A	1st Grade Overseer, Irrigation Quality Control Sub Division, Thrissur		
20	Ammad.P.C	Assistant Director Coastal Erosion Studies Section, Parappanangadi	Training on General Practices in Soil investigation & Basic awareness on Geotechnical and Construction Materials Laboratory testing at KERI Peechi, Thrissur.	13.02.2020-15.02.2020
			2. Coastal Data Collection and Design of Coastal Structures, IMG, Thiruvananthapuram	24.02.2020-25.02.2020
21	Arsha Nath P R	Assistant Director, Coatsal Engineering section, Kollam	STP-619 Training for Assistant Engineers of the Irrigation Dept. at IMG, Thiruvananthapuram	1/07/2019-06/07/2019
22	Ajin Singh S	Assistant Director,Coastal Engineering Section, Thiruvananthapuram	Hydrology - Data Collection , Validation and Analysis.	04.02.2019-06-02-2019
			Capacity Building Programme for Assistant Engineers at IMG, TVM.	23.09.2019-28.09.2019

I. COASTAL ENGINEERING FIELD STUDIES, THRISSUR

I.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 576 Km. in the south west coast of India, is Characterized by a narrow longitudinal barrier strip of low-lying land, sand-witched 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 waters 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. 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 influence of saline water through mouth of rivers also affects 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 and seawalls 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 Engineering field Studies from time to time, as per the above guideline and also keep a copy of the same for reference. The offices under this office are

1. Coastal Engineering Sub Division Kollam

a) Coastal Engineering Section, Thiruvananthapuram: The jurisdiction of coastal area comprises of Kollamkode to Paravoor pozhi (CP 0000 to CP 0287)

b) Coastal Engineering Section, Kollam: Jurisdiction of coastal area comprises of Paravoor pozhi to Kayamkulam pozhi (CP 0288 to CP 0499)

c) Coastal Engineering Section, Thottappally: Jurisdiction of coastal area comprises of Kayamkulam pozhi to Alapuzha pier. (CP 0500 to CP 0710)

The total coastal area of Kollam Sub Division is **164.596 Km.**

2. Coastal Engineering Sub Division Ernakulam

a) Coastal Engineering Section, Cherthala: Jurisdiction of coastal area comprises of Alappuzha pier to Chellanam. (CP 810 to CP 975)

b) Coastal Engineering Section, Ernakulam: Jurisdiction of coastal area comprises of Chellanam to Munambam. (CP 975 to CP 1187)

c) Coastal Engineering Section Chavakkad: Jurisdiction of coastal area comprises of Azhikode to Ponnani. (CP 1188 to CP 1549)

The total coastal area of Ernakulam Sub Division is **152.635 Km.**

3. Coastal Erosion Studies Sub Division Kozhikode

a) Coastal Erosion Studies Section, Parappanangadi: Jurisdiction of coastal area comprises of Padinjarekkara to Kadalundi (CP No. 1555 to CP 1743)

b) Coastal Erosion Studies Section, Kozhikode: Jurisdiction of coastal area comprises of Kadalundi to Poozhithala Mahipalam. (CP 1745 to CP 2120)

c) Coastal Erosion Studies Section, Thalassery: Jurisdiction of coastal area comprises of Mahi River to Thalapady river Manjeswaram. (CP 2140 to CP 2412 in Kannur District and CP 2507 to 2750 of old CP in Kasargode District).

The total coastal area Kozhikode Sub Division is **259.1 Km.**

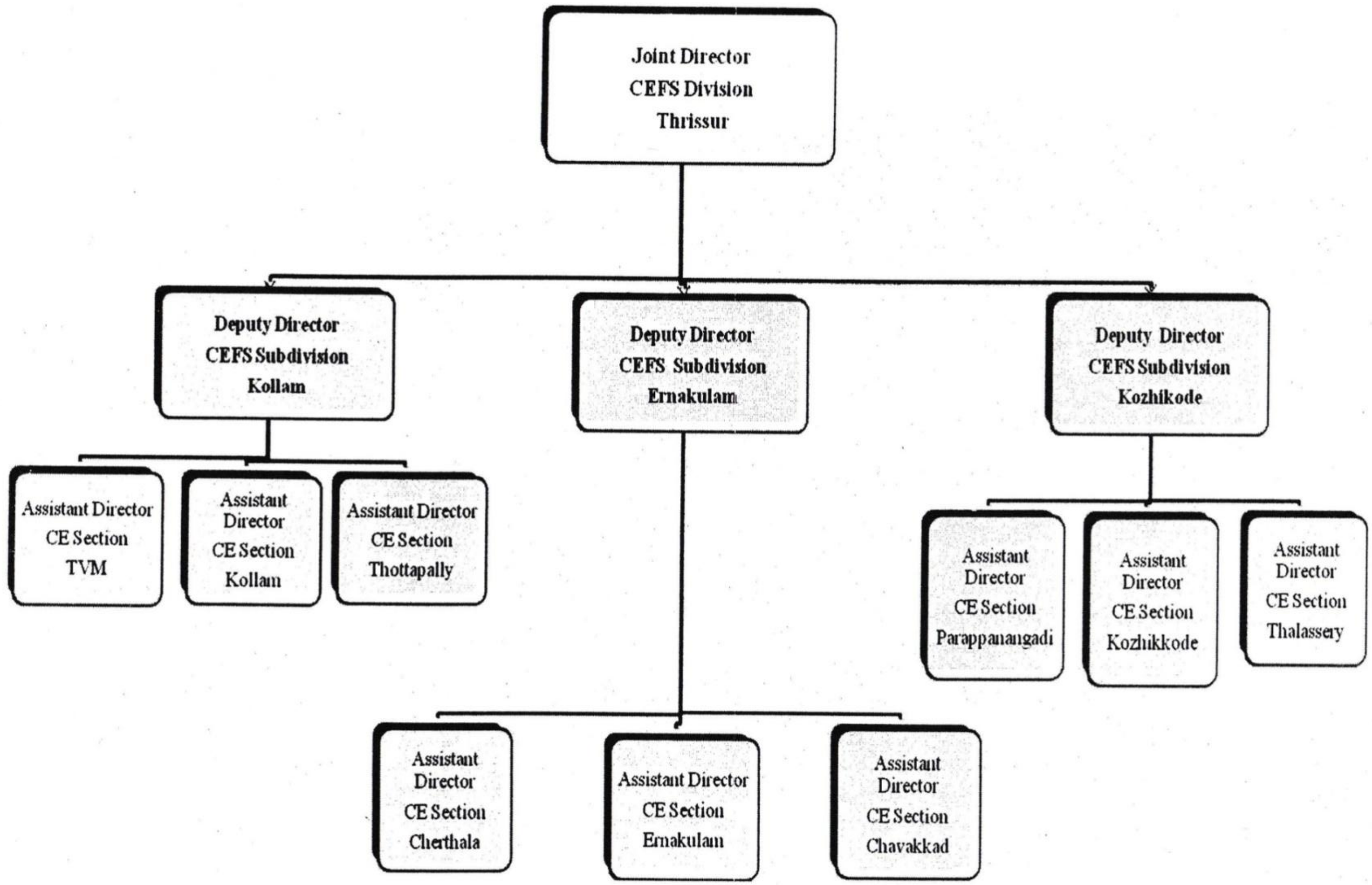
I.2 General Arrangements and Field Studies

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 ofthe Deputy Directors and further sub divided into the control of the Assistant Directors. The three regions come under the Coastal

Engineering Field Studies, headed by the Joint Director who works under the guidance of the Director, Fundamental and Applied Research, Kerala Engineering Research Institute, Peechi.

ORGANISATIONAL SET UP

Name of Sub Divisions and Sections Under Coastal Engineering Field Studies Division, Thrissur



I.3 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 processes. 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 mansoon and regains its original profile during fair weather season. However, at some places erosion is of permanent nature.

I.3.1 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 each materials, characteristics of littoral drifts, shore history and they are recorded on standardized format.

I.3.1.1 Study of littoral drift

Littoral transport is the movement of sediments in the near shore zone by waves and currents. This transport of suspend 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.

I.3.1.2 Study of Wind and Waves

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 depend on wave characteristics and since these studies are essential.(Predominant direction of waves is from West or North West)

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 25Km 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 2019 are as follows:

Sl.No.	Month	Date of observation
1.	April	05/04/2019
2.	May	04/05/2019
3.	June	03/06/2019
4.	July	01/08/2019
5.	August	30/08/2019
6.	September	28/09/2019
7.	October	27/10/2019
8.	November	26/11/2019
9.	December	26/12/2019
10.	January	24/01/2020
11.	February	23/02/2020

12.	March	24/03/2020

Details of Simultaneous Observations

Sl.No.	Name of Station	Time and CP Nos				
		9.00 AM	10.00 AM	11.00 AM	11.45 AM	12.30 AM
1.	Vettukkad	0112	0114	0116	0114	0112
2.	Anjengo	0223	0228	0233	0228	0223
3.	Eravipuram	0317	0322	0327	0322	0317
4.	Thottappally	0597	0600	0602	0600	0597
5.	Alapuzha	0704	0707	0710	0707	0704
6.	Thanki	0926	0930	0935	0930	0926
7.	Kannamali	1025	1037	1047	1037	1025
8.	Kuzhuppilly	1140	1147	1149	1147	1140
9.	Perinjanam	1269	1274	1279	1274	1269
10.	Nattika	1323	1330	1333	1330	1323
11.	Blangad	1418	1421	1428	1421	1418
12.	Vakkad	1595	1599	1605	1599	1595
13.	Calicut	1830	1826	NCP	1826	1830
14.	Melody	2013	2009	2004	2009	2013
15.	Thalassey (Old CP)	Back of Bishop's House	1067	1075	1067	Back of Bishop's House
16.	Kanhangad	2608	2603	2598	2603	2608
17.	Kasargod (Old CP)	531	541	550	541	531
18.	Kannuvatheertha (Old CP)	103	111	121	111	103

I.3.2 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.

I.3.3 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.

I.3.4 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.

I.3.5 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.

I.3.6 Taking cross section profile of the beach

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

I.3.7 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, the Deputy Director and the Assistant Director of the Coastal Sub Division & Sections concerned, and approved the alignments of sea walls along Kerala Coast, considering the last 5 year 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 2019.

Sl. No.	Name of sub Division	Alignment approved during 2019	Essentialitycertificate issued during 2019
1	CE SubDivision, Kozhikode	Nil	Nil
2	Ernakulam CE SubDivision	1No	1No.
3	Kollam CE SubDivision	Nil	Nil

I.4 Performance of the Division in the Year 2019

With in 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 2017. The performance can be summarized as follows.

I.4.1 Types of works

1.	Topographic survey conducted for determining beach profiles	:	Nil
2.	Periodical measurement of shoreline changes	:	4188.897 Km
3.	Simultaneous observations	:	202 Set
4.	Soil sample collected	:	48Set
5.	Cross section profiles	:	Nil
6.	Levels connected	:	Nil
7.	C.P Stones planted	:	Nil
8.	Alignment stones planted	:	Nil
9.	Kilometre stones planted	:	Nil

10.	Bench mark stones plant	:	Nil
11.	Alignment fixed by Joint Director	:	1 No.
12.	Details of damages at various places in the Coastal beaches collected	:	72 Nos.
13.	Mud bank study	:	Nil

I.4.2 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	:	1464.00 Km
Ernakulam Sub Division	:	1078.697 Km
Kozhikode Sub Division	:	1646.20 Km

3. Taking simultaneous observation

Kollam sub Division	:	50 Set
Ernakulam Sub Division	:	72 Set
Kozhikode Sub Division	:	80 Nos.

4. Taking photograph

Kollam Sub Division	:	45Nos
Ernakulam Sub Division	:	22 Nos
Kozhikode Sub Division	:	79 Nos.

5. Soil sample collected

Kollam Sub Division	:	20 Set
Ernakulam Sub Division	:	14 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 theCoastal beaches collected

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

14. Study of Mudbank

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.

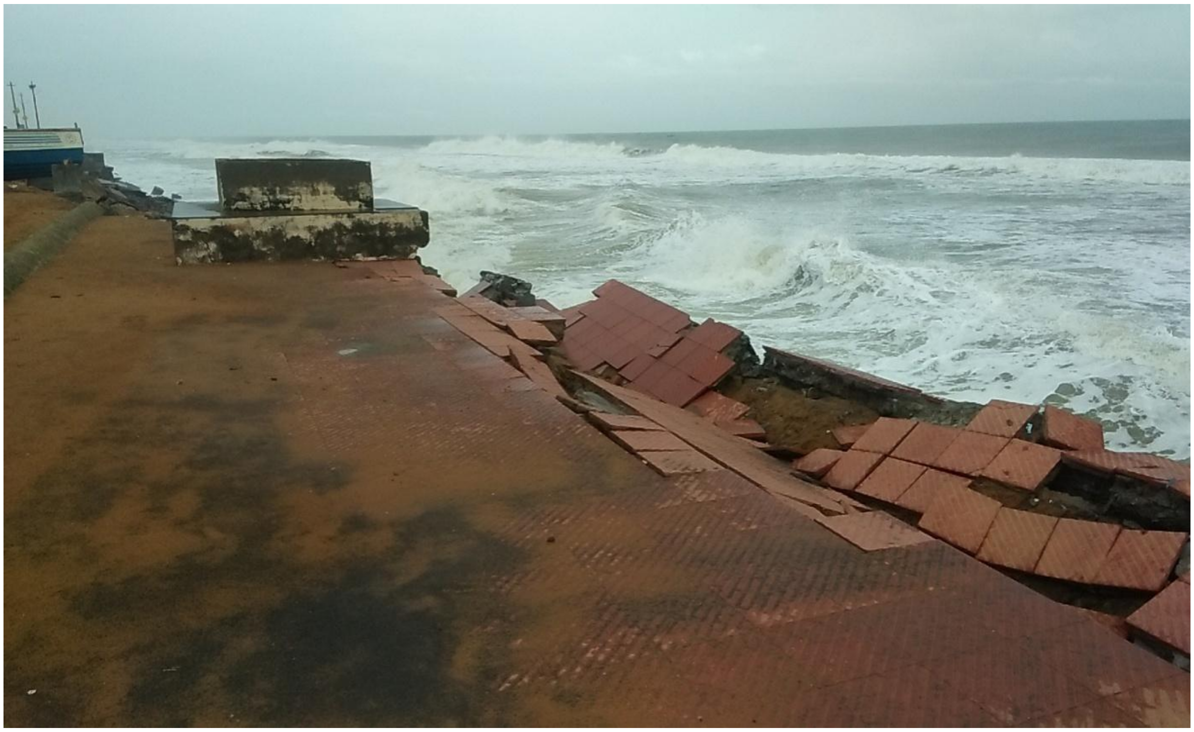
Coastal Damages under Kozhikode sub division

Damages under Kollam SubDivision


2019/12/2 13:19

Damaged and collapsed sea wall atValiyathura

Damaged sea wall at Poonthura&Damaged road at Sangumugam Road



Damaged foot path at Sangumugambeach

Damaged sea wall at Beepapally

Damaged houses at Valiyathura

Damage of coast at Vettukadu during monsoon season

CP between 0283 & 0234

Damaged sea wall at Poothura


Damaged and collapsed sea wall atEdava

Damaged houses at Anjuthengu

Damages under Ernakulam Sub Division

I.5 Details of Different Stones

Sl. No.	Description	Thiruvananthapuram	Kollam	Thottapally	Cherthala	Ernakulam	Chavakkad	Parappanangadi	Kozhikode	Thalassery	Total
1.	C. P. Stones	288	212	211	166	212	299	189	372	524	2473
2.	Alignment Stones	288	212	211	166	212	322	189	372	524	2596
3.	Guard Stones	48	36	32	28	36	52	28	64	84	408
4.	K. M. Stones	79	42	42	30	43	69	39	76	105	525
5.	B. M. Stones	12	9	8	7	9	13	7	16	21	102

List of Important Structures

I.5.1 Coastal Engineering Cherthala Section

Sl.No	Name of important structures	Place	Between CP
1	Light house	Alappuzha	CP810
2	Bishop house	Alappuzha	CP811-812
3	Recreation club	Alappuzha	CP810
4	Fish landing centre	Pollethai	CP857-858
5	Fish landing centre	Arthunkal	CP910-911
6	Arthunkal church	Arthunkal	CP904-905
7	Church	Ottamassery	CP926
8	Church	Thankey	CP929-930
9	Light house	Andhakaranazhi	CP951-952
10	Church	South Chellanam	CP975

I.5.2 Coastal Engineering Chavakkad Section

1.	Coastal Police Station at AzhikkodeNear CP. 1188
2	Light House AtAzhikkodeBetween CP .1201 – 1202
3	Beach Park At Snehathiram Near Thalikkulam Between CP. 1334 – 1336
4	Groyene At Chettuva Near CP.No. 1380
5	Groyene at Chettuva (N) Near CP. 1381
6	Light House at Thottappu Near Blangad Between CP. 1406 – 1407
7	A MultyStoryed Lodge Building at Blangad Between CP. 1419 – 1420
8	Single Storey Building of Fisheries Department Between CP.1499 -1500 (Damaged)
8	MultyStorey Building Hatchery at Veliancode for Fisheries Between CP. 1510 – 1512
9	BeeviJaram At Puduponnani near CP.1514
10	Light House AtPonnaniBetween CP. 1548 -1549

I.5.3 C. E.S Section, Parappanangadi

1.	Azhimugham CP 1555
2.	Road and Mosque CP 1562
3.	3. MMM HS Koottayi CP 1575
4.	Koottayi School CP 1581
5.	Kootaiyi Town CP 1585
6.	Koottayi Badar Masjid CP 1595
7.	Vakkad CP 1604
8.	Malayalam Univercity CP 1606
9.	Arikkanchira CP 1613
10.	Paravanna Beach CP 1617
11.	Unniyal Beach CP 1626
12.	Puthiyakadappuram South CP 1631
13.	Puthiya Kadappuram CP 1640
14.	Puthiya Kadappuram North CP 1650

15.	Tanur harbor CP 1660,1661,1662,&1663
16.	Pandara Kadappuram CP 1668
17.	Poorapuzha Azhi CP 1684
18.	Parappanangadi CP 1705
19.	Chettipadi CP 1711
20.	Anangadi Turtle hatchery CP 1724
21.	Kadalundy Nagaram CP 1730
22.	Kadalundy CP 1743

I.5.4 C.E.S. Section, Kozhikode

1.	Kadalundi CP 1745	**42.**	Cheriya-Mangad CP 1930
2.	Nechkkattu Paramba CP 1750	**43.**	Koyilandy CP 1935
3.	Kappalangadi CP 1755	**44.**	Valiyath Palli Beach CP 1940
4.	Anchukudikkal CP 1760	**45.**	Kollam Beach CP 1945
5.	Thai Kadappuram CP 1765	**46.**	Parappally Beach CP 1951
6.	Chaliyar CP1770	**47.**	Manda Mangalam CP 1955
7.	Chaliyar CP1771	**48.**	Urupunya Kavu Beach CP 1960
8.	Beypore Port CP 1772	**49.**	Moodadi Beach CP 1965
9.	Savakandy paramba CP 1775	**50.**	Muthayam Kadapuram CP 1970
10.	Gotheeswaram Beach CP 1780	**51.**	Kunhi-Thayyil Palli CP 1975
11.	Kaithavalappu CP 1785	**52.**	Palliparmba ,Kadalur CP 1980
12.	Marad S Beach CP 1790	**53.**	Kodikkal South CP 1985
13.	Marad N Beach CP 1795	**54.**	Kodikkal CP 1990
14.	Payyanakkal Beach CP 1800	**55.**	Kodikkal UP School CP 1995
15.	Chamundi Valappil CP 1805	**56.**	Kodikkal North CP 2000
16.	Kothi Beach CP 1810	**57.**	Thokkodi CP 2005
17.	Mukhadar Beach CP 1815	**58.**	Melady Beach CP 2010
18.	Kozhikode South Beach CP 1820	**59.**	Bhagavan –Mukku-CP 2020
19.	Kozhikode Beach CP 1825	**60.**	Ayanikkad CP 2025
20.	Kozhikode North Beach CP 1830	**61**	Kolavi –Palam Road CP 2030
21.	Thoppayil Beach CP 1835	**62.**	Kolavi Palam CP 2035
22.	Konad Beach CP 1840	**63.**	Iringal CP 2040

23.	Butt Road CP 1845	**64.**	Moorad CP2043
24.	Puthiyangadi Beach CP 1850	**65.**	Moorad CP2044
25.	Edakkal Beach CP 1855	**66.**	Moorad CP 2045
26.	Puthiyappa CP 1860	**67.**	Sandbanks Vadakara CP 2046
27.	Puthiyappa Harbour CP 1865	**68.**	Kottakkal CP 2050
28.	Narachal Beach CP 1850	**69.**	Vadakara CP 2055
29.	Elathur CP 1875	**70.**	Anati-Bhagam CP 2060
30.	Elathur Azhi CP 1880	**71.**	Mukachery CP 2065
31.	Korappuzha CP 1883	**72.**	Kuriyadi CP 2070
32.	Korappuzha CP 1884	**73.**	Thazhe Palli CP 2075
33.	Korappuzha CP 1885	**74.**	Muttungal Beach CP 2080
34.	Kannankadavu CP 1890	**75.**	Maliyekkal Beach CP2085
35.	Munambath Beach CP 1895	**76.**	Karuvachalil CP 2090
36.	Kakkachikandi CP 1900	**77.**	Madakkara Beach CP 2095
37.	Kappad Beach CP 1905	**78.**	Mukkali Beach CP 2100
38.	Kappad North Beach CP 1910	**79.**	Avikkara Beach CP 2105
39.	Thuvappara CP 1915	**80.**	Erikkal Chalil CP 2110
40.	Parakkal Thazhe CP 1920	**81.**	Azhiyur Chungam CP 2115
41.	Ezhuku-dikkal CP 1925	**82.**	Poozhithala Mahi CP 2120

I.5.6 Coastal Engineering Section, Thiruvananthapuram

I.5.6.1 CHURCH

Sl.No.	CP Stone b/w	Name
1.	0000 & 0001	KollamcodeKochupalli
2.	0004& 0005	St.Mathew's Church
3.	0005 & 0006	St.MarrysMagdelence Church
4.	0019 & 0020	St.Berthodony Church
5.	0024 & 0025	St.Andrews Church
6.	0025 & 0026	Church of God
7.	0029 & 0030	St. Anthonys Church kochuthura
8.	0036 & 0037	
9.	0078 & 0079	St.ThomasrChurchrPoonthura
10.	0088 & 0089	St.AssemptionrChurchCheriyathura
11.	0094 & 0095	St.Antony'sForance Church
12.	0110 & 0111	St.Peter's Church
13.	0115 & 0116	Vettukadu Church
14.	0122 & 0123	St.Joseph Church
15.	0128 & 0129	St.Thomas Church Veli

16.	0152 & 0153	Pallithura Church
17.	0153 & 0154	St.Thomas Aquinas Church
18.	0156 & 0157	
19.	0160 & 0161	St.Dominic Church
20.	0163 & 0164	St.Andrews Church
21.	0171& 0172	Puthenthope Church
22.	0187 & 0188	St.Joseph's Church
23.	0197 & 0198	St.Micheal's Church
24.	0220 & 0221	St.Roche's Church
25.	0226 & 0227	St.Joseph Church
26.	0233 & 0234	St.Antony's Church
27.	0234 & 0235	Holy Spirit Church Mampally

I.5.6.2 TEMPLE

Sl. No.	CP Stone b/w
1	0062 & 0063
2	0063 & 0064
3	0064 & 0065 (2 numbers)
4	0068 & 0069
5	0234 & 0235
6	0238 & 0239
7	0239 & 0240
8	0242 & 0243
9	0282 & 0283
10	0283 & 0284
11	0284 & 0285

I.5.6.3 MAZJID

Sl. No.	CP Stone b/w
1	0056 & 0057
2	0062 & 0063
3	0084 & 0085
4	0204 & 0205
5	0209 & 0210
6	0253 & 0254
7	0256 & 0257
8	0260 & 0261

9	0274 & 0275 (2 numbers)
10	0281 & 0282
11	0283 & 0284(2 numbers)

I.5.6.4 KURISADI

Sl. No.	CP Stone b/w
1	0009 & 0010
2	0018 & 0019
3	0027 & 0028
4	0036 & 0037
5	0038 & 0039
6	0042 & 0043
7	0093 & 0094
8	0123 & 0124
9	0157 & 0158
10	0163 & 0164
11	0210 & 0211
12	0213 & 0214
13	0218 & 0219
14	0228 & 0229

I.5.6.5 FISH LANDING SHED

Sl. No.	CP Stone b/w	Sl. No.	CP Stone b/w
1	0000 & 0001	17	0034 & 0035 (3 no)
2	0002 & 0003	18	0035 & 0036 (2 no)
3	0004 & 0005	19	0037 & 0038
4	0008 & 0009(2 no)	20	0039 & 0040
5	0018 & 0019	21	0040 & 0041 (2 no)
6	0019 & 0020	22	0041 & 0042 (3 no)
7	0020 & 0021	23	0042 & 0043
8	0024 & 0025	24	0043 & 0044 (4 no)
9	0025 & 0026	25	0183 & 0184
10	0026 & 0027	26	0189 & 0190 (2 no)
11	0027 & 0028 (2 no)	27	0193 & 0194

12	0028 & 0029	28	0194 & 0195 (2 no)
13	0030 & 0031 (2 no)	29	0223 & 0224
14	0031 & 0032 (2 no)	30	0253 & 0254
15	0032 & 0033 (2 no)	31	0256 & 0257
16	0033 & 0034 (2 no)	32	0257 & 0258

I.5.6.6 ANGANAVADI

Sl. No.	CP Stone b/w
1	0008 & 0009
2	0035 & 0036
3	0043 & 0044
4	0130 & 0131
5	0281 & 0282

I.5.6.7 OTHERS

Sl. No.	CP Stone b/w	Name
1	0000 & 0001	Rajiv Gandhi centre for Aqua culture
2	0002 & 0003	V.R food enterprises Pvt. Ltd
3	0011 & 0012	Mini park
4	0012 & 0013	Coastal Police station
5	0020 & 0021	Foot ball ground
6	0029 & 0030	Foot ball ground
7	0031 & 0032	Foot ball ground
8	0036 & 0037	Matsyabhavan
9	0036 & 0037	St. Xavior's library & sports club
10	0037 & 0038	Kala Sagar Arts & sports club
11	0039 & 0040	Pulluvila fish market
12	0041 & 0042	Mini park
13	0044 &0055	Somatheerambeach,Vizhinjamport,Vizhinjam light house,Kovalambeach,Leela resort.
14	0055 & 0056	Kovalam beach
15	0056 & 0057	KTDC Resrot
16	0057 & 0059	Bait Resort
17	0057	Samudra beach

18	0062 & 0063	Coir factory
19	0094 & 0095	Valiyathura bridge
20	0103 & 0107	Sangumugam beach
21	0103 & 0107	Airport
22	0105 & 0106	Art museum
23	0106 & 0107	Sangumugam palace
24	0107 & 0108	Holy cross hospital &Pratheeksha De addiction centre
25	0118 & 0120	Titanium factory
26	0125 & 0127	VeliTouist villa
27	0131 & 0132	Primary health centre
28	0137 & 0149	ISRO (VSSC compound)
29	0152 & 0153	Pallithura higher secondary school
30	0157 & 0158	L P School
31	0161 & 0162	St. Xavior'scricket stadium
32	0162 & 0163	St. Xavior's college
33	0171 & 0172	Stella Marry's convent
34	0178 & 0179	Sea boy fisheries Pvt.Ltd.
35	0210 & 0211	Perumathura break water & bridge
36	0211 & 0212	Fishing harbor, Coastal Police Station,Harbour Engineering sub division.
37	0223 & 0224	Anjuthengu Fort, Anjuthengu Light House, Community Health Centre,Sacret heat convent.
38	0225 & 0226	School
39	0226 & 0227	Foot ball ground
40	0227 & 0228	Anjuthengu Panchayath Office
41	0228 & 0229	St. Thomas library
42	0229 & 0230	Anjuthengu Service co-operative Bank
43	0233 & 0234	St.Antony's L P School
44	0238 & 0239	KayikkaraAsanSmarakam& Asan Memorial L P School
45	0240 & 0241	Community health centre
46	0250 & 0251	Arivalam Tourist Park
47	0259 & 0260	Varkkala beach & cliff
48	0268 & 0270	Kappil beach
49	0273 & 0274	Mini park
50	0281 & 0282	Library
51	0287 & 0288	Mini park

I.5.7 Coastal Engineering Section Kollam

Sl. No.	Name	
1	PWD Kadavu at Mukkam	CP 0292
2	Temple at Thanni	CP 0302
3	Church at Thanni	CP 0303
4	Church near Eravipuram	CP 0315
5	Pier of Port Department at Garfill Nagar	CP 0317
6	Gandhi Park at Kochupilamoodu	CP 0331
7	Church at Pallithottam	CP 0336
8	Kollam Port	CP 0336
9	Church at Vadi (MoothakkaraPalli)	CP0341
10	Fishing Harbour at Thankasseri	CP 0343
11	Light House at Thankasseri	CP0347
12	Temple at Thirumullavaram	CP 0357
13	Church at Thirumullavaram	CP 0359
14	Church at Sakthikulangara	CP 0376
15	GTS Benchmark at Neendakara	CP 0381
16	Fishing Harbour Port (Breakwater and Bridge) at Neendakara	CP 0381
17	P.B.M and M.C Health Centre at Neendakara	CP 0393
18	St. Francis Church at Karithura	CP 0402
19	Light House and IRE Company at Karithura	CP 0408
20	KMML Ltd at Kovilthottam	CP 0409
21	Church at Kovilthottam	CP 0414
22	St. Francis Church at Karithura	CP 0415
23	Temple at Kattilkadavu	CP 0421
24	Parayakadavu Church	CP 0437
25	Parayakadavu Bridge	CP 0439
26	Temple at Cheriyazheekkal	CP 0446
27	Cheriyazheekkal Football Association Club	CP 0452
28	Govt. Homoe Dispensary at Kuzhithura	CP 0463
29	SreeAmruthanandamayee Matt and Ayurveda Treatment Centre	CP0470
30	Pachimeswaram Temple	CP 0477
31	Govt. LP School at Srayikadu	CP 0490

32	Fishing Harbour Port (Breakwater near KayamkulamPozhi)	CP 0499
33	PWD Kadavu at Mukkam	CP 0292
34	Temple at Thanni	CP 0302
35	Church at Thanni	CP 0303
36	Church near Eravipuram	CP 0315
37	Pier of Port Department at Garfill Nagar	CP 0317
38	Gandhi Park at Kochupilamoodu	CP 0331
39	Church at Pallithottam	CP 0336
40	Kollam Port	CP 0336
41	Church at Vadi (MoothakkaraPalli)	CP 0341
42	Fishing Harbour at Thankasseri	CP 0343
43	Light House at Thankasseri	CP0347
44	Temple at Thirumullavaram	CP 0357
45	Church at Thirumullavaram	CP 0359
46	Church at Sakthikulangara	CP 0376
47	GTS Benchmark at Neendakara	CP 0381
48	Fishing Harbour Port (Breakwater and Bridge) at Neendakara	CP 0381
49	P.B.M and M.C Health Centre at Neendakara	CP 0393
50	St. Francis Church at Karithura	CP 0402
51	Light House and IRE Company at Karithura	CP 0408
52	KMML Ltd at Kovilthottam	CP 0409
53	Church at Kovilthottam	CP 0414
54	St. Francis Church at Karithura	CP 0415
55	Temple at Kattilkadavu	CP 0421
56	Parayakadavu Church	CP0437
57	Parayakadavu Bridge	CP 0439
58	Temple at Cheriyazheekkal	CP 0446
59	Cheriyazheekkal Football Association Club	CP 0452
60	Govt. Homoe Dispensary at Kuzhithura	CP 0463
61	SreeAmruthanandamayee Matt and Ayurveda Treatment Centre	CP0470
62	Pachimeswaram Temple	CP 0477
63	Govt. LP School at Srayikadu	CP 0490
64	Fishing Harbour Port (Breakwater near KayamkulamPozhi)	CP 0499

I.5.8 Coastal Engineering SectionThottappally

1	Port building at Alappuzha	CP 710
2	W&C Hospital	CP 708
3	Village office building	CP 706
4	ESI hospital	CP 703
5	SSV LP School Vadakkal	CP 697
6	Catholic church Paravoor	CP 687
7	Catholic church Punnapra	CP 680
8	Industrial unit Khadi and Village Industries-Punnapra	CP 676
9	Auction hall of Harbour Engineering -Valanjavazhi	CP 656
10	Railway line at Kakkazham	CP 651
11	Malsyafed building at Ambalappuzha	CP 646
12	LP School at Anandeswaram	CP 619
13	ThottappallyHarbour	CP 609
14	Health Centre at Thottappally	CP 609
15	Coastal Engineering Section at Thottappally	CP 604
16	Spillway at Thottappally	CP 605
17	Mosque and Church at Chelakkad	CP 578
18	Thrikkunnappuzha Temple	CP 573
19	Mosque at Pathiyankara	CP 563
20	Mangalam Water Tank	CP 557
21	Corporation Bank, Arattupuzha	CP 547
22	Nallanickkal Church	CP 535
23	Break water at Valiyazheekkal	CP 500

I.6 Tourism Development Projects Under This Subdivision

Sl. No.	Particulars	District	Nearby Town/ City	Old CP No	New CP No	Contro-lling Autho-rity	Status (Existing or to be developed)	Remarks
1	Purathoor Azhimugham Beach	Malappuram	Padinjarekkara	3365	1555	Tourism Dept	Exising Tourism project	River Bharathapuzha & Tirur Puzha joins Arabian sea. Jankar service available to Ponnani
2	Poorapuzha Azhimugham Beach	Malappuram	Thanoor	3116	1682	Tourism Dept	Tourism to be developed	River Poorapuzha joins Arabian sea.
3	Kadalundi Beach	Malappuram & Kozhikode	Kadalundi	2997	1742	Tourism Dept	Exising Tourism project	River Kadalundi joins Arabian sea. This is a bird sanctuary with more than 60 species of migratory birds
4	Beypore Beach	Kozhikode	Kozhikode	2948	1769	Harbour Engineering &Toursim Dept	Exising Tourism project	Walk way(Pulimuttu) constructed into the sea for 1 km. Has traditional Ship Building centre, famous for Beypore Uru . & Dolphin view point
5	Kozhikode Beach	Kozhikode	Kozhikode	2840	1826	Tourism Dept	Exising Tourism project	Famous for sunset view. Has light house and two damaged iron screw pile pier platform, ,run into the sea for 120m . Adjacent to beach is Lions Park and marine water aquarium
6	Korappuzha Estuary	Kozhikode	Kozhikode	2727	1882		Tourism to be developed	Korapuzha backwaters joins sea. Offers a splendid and scenic view of natural beauty

7	Kappad Beach	Kozhikode	Kozhikode	2695	1910	Tourism Dept	Exising Tourism project	16 km from Kozhikode towards north. Portuguese explorer Vasco-Da Gama landed here in 1498. This is a rock studded beach
8	Velliyamkallu	Kozhikode	Payyoli	2483	2025		Tourism to be developed	A massive rock called Velliamkallu associated with Kunhali Marakkar situated 13km off sea cost (into the sea). This was the hiding ground for Marakkar to attack the invading Portuguese
9	Kolavipalam beach	Kozhikode	Iringal	2451	2041	Forest Dept	Tourism to be developed	Also called turtle beach. Every year olive ridley turtle comes from Pacific ocean to lay the eggs here. Turtle hatchery centre
10	Muzhippilangad Drive- in Beach	Kannur	Thalassery	1057 /62	2224	Tourism Dept	Exising Tourism project	Largest drive in beach in Asia.15 km south of the town. Has beach festival
11	Dharmadam Island	Kannur	Dharmadam		2208	Private	Tourism to be developed	The island has backwaters covered with coconut groves and dense bushes .During low tide one can walk from the Muzhippilangad beach
12	Kizhunna Ezhara beach	Kannur	Kizhunna		2245		Tourism to be developed	11 km form kannur , Good tourist spot to spend vacations and relish beautiful surroundings

13	St Angelo's Fort	Kannur	Kannur cantonment		2282	Archeological survey	Exising Tourism project	Built in 1505 by Don Francisco de Almeida, the first portuguese viceroy of India. important historical monument and beautiful tourist spot
14	Payyambalam Beach	Kannur	Kannur	1046 to 1031	2302 to 2309		Tourism to be developed	Has approx. 4 km of shore line, a flat laterite cliff and beautifully landscaped sculpture of mother and child .Mappila bay, the harbor, has boat rides which offers spectacular view
15	Meenkunnu beach	Kannur	Meenkunnu		2339		Tourism to be developed	Located in Azhikode village. Got vast stretch of golden sand and coconut trees. Famous for fish (meen -fish kunnu -small hill)
16	Ezhimala beach	Kannur	Ezhimala		2430	Naval Academy	Tourism to be developed	About 55 km from Kannur. Between Payannur and Payangadi route. Serene environment and good for peace loving visitors
17	Bekal Fort	Kasaragode	Bekal		2657	Archeological survey	Exising Tourism project	Fort spread over 40 acres has massive walls of 12m height runs into the sea with fine bay towards south. Voids in walls were used for placing cannons

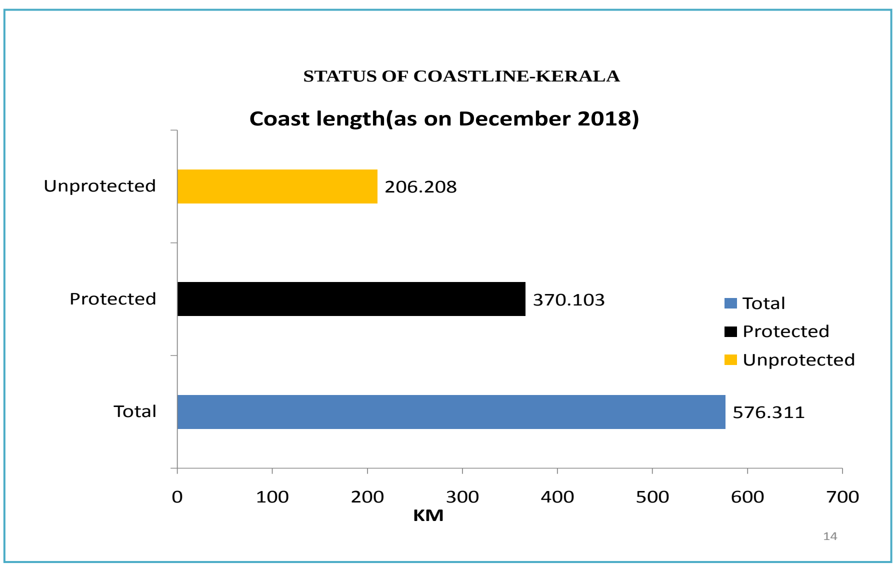
I.7 Details of Works

I.7.1. Planting of New Controlpoint Stones, Alignment Stones, Kilometer Stones and Bench Mark 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. B.M. 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.

I.7.2 Investigation Works

Field studies and collection of data on coastal erosion have been conducted on all Sections under this Division.



Coastal Status during the year 2019 is under preparation

I.8 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. 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 9.6.2000 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.

Coastal Engineering Section, Thalassery coming under the control of Deputy Director, Kozhikode Sub division extends from Mahe to Manjesweram with a length of 148km. At present only 90 km 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 100 lakhs during the nineteen nineties, has got reduced considerably in the recent years to 5 lakhs 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.

25 Kms of stones are not planted on the Northern Side of Kerala ie, in North of Kasargode District. So no details of sea have been taken in that area. That is to be rectified immediately.

Also some stones are missing in the rest of the area, and it should be replanted immediately. Maintenance of the stones are not done till date. It is also to be done urgently.

As per the direction of Chief Engineer, I&A, TVM, the Jeep under CEFS Division has been transferred to MI Division Thrissur, the non-availability of vehicle affects the inspection of the sites.

I.9 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 to55 and the construction work is in progress.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 charecteristics 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.

I.10 Conclusion

Specific studies are necessary for studying the behaviour of shore protection works like seawall, groynes and break water.The study has to be conducted for analyzing the shore particulars before and after the construction of the groyne field. The construction of new international Vizhinjam harbour was started in between CP No.0044 to 0055 and the construction work is in progress. This area needs some specific studies.

The main constrains is the lack of modern equipments and the shortage of fund for the study work of Coastal Engineering Department. It is also required to study the possibility of artificial nourishment and other protection works like geotube construction. The existing coastal protection works are being watched. The general behaviour including its failure if any is studied for modification.

Since the study of the coastal characteristics is the base for all constructions of anti-sea erosion structures and also for the other construction work, the data collection could not be stopped. If it is stopped the entire data collected till date will be futile. Now many numbers of CP &AS stones are missing/damaged and hence these are to be replanted and also to be reestablished the Reduced Level (RL) and their locations (Latitude & Longitude).

The studies and data collection on coastal erosion are being continued during 2019-2020 possible erosion causes are wave action, tidal action, storm surge and manmade causes. Latitude and Longitude of all Control Point Stones and Alignment Stones and Seawall are taken for Coastal Atlas Preparation. Special studies if any required shall be done as directed. Hence Coastal Engineering and Field studies take inevitable part for the developing of coastal region of Kerala.

J. QUALITY CONTROL DIVISION,THRISSUR

J.1 Introduction

The quality control wing under Irrigation Department was formed in 1995 as per G.O.(MS)No.87/1995/Irrgn dated:13/06/995 to ensure quality of the works executed by Irrigation Department (WRD). There are two division offices under the wing one at Thrissur with jurisdiction extending from Ernakulam to Kasargod (8 districts) and the other at Kottarakkara with jurisdiction extending from Thiruvananthapuram to Kottayam (6 districts).

Quality Control Division, Thrissur.

Quality Control Division, Thrissur was formed with effect from 15/11/2000 for Checking and maintaining the quality of works under taken by the Irrigation Department, after abolishing KIP (MCS Division) 2 at Charumoodu as per Govt. order (RE) No.891/2000/IRD Dated: 12/07/2000. Up to 04/03/2010, this division was functioning under the control of Superintending Engineer, I&P Circle, Thrissur. From 05/03/2010 onwards this division is functioning under the direct control of the Director, F&AR,KERI, Peechi as per the Govt. Order No. 10 /2010 Dated:1/2/2010.

The Quality Control Division, Thrissur comprises of a division office at Thrissur and 5 Sub Division Offices at Muvattupuzha, Thrissur, Palakkad, Kozhikode and Kannur. Monitoring of works executed by the Irrigation Department in Ernakulam, Thrissur, Palakkad, Malappuram, Kozhikode, Wayanad, Kannur and Kasargod are carried out by Quality Control Division, Thrissur.

The main objects of the formation of 5 subdivisions under the Quality control Division, Thrissur and its functions.

1. **Thrissur** Sub Divisionand its two sections atThrissur and Ernakulam are envisaged to check the quality of works under taken by the various Execution divisions and Subdivisions of the irrigation department in Thrissur and Ernakulam Districts.

2. **Palakkad** Sub Division and its two sections at Palakkad and Malapuram are intended to check the quality of works under taken by the various Divisions and Sub divisions of the Irrigation Department in Palakkad and Malapuram Districts.

3. **Kozhikode** Sub Division and its sections namely Kozhikode and Kalppetta are intended to check the quality of works under taken by the various Divisions and Sub divisions of the Irrigation Department in Kozhikode and Wyanad Districts.

4. **Kannur S**ub division and its two Sections at Kannur and Kasargod are intended to check the quality of works undertaken by the various Divisions and Subdivisions of Irrigation department in Kannur and Kasargod Districts.

5. **Muvattupuzha** Sub Division was formed on deploying the Chimoni Dam Project in Thrissur District on 1/1/1992 as per GO(Rt) 717/91 Dt. 07/10/1991. The main object of this Sub division is to check the quality of works in two divisions of MuvattupuzhaVallley Irrigation Project and two divisions of Idamalayar Irrigation Project. There are three sections at Muvattupuzha, Koothattukulam, and Angamaly for this purpose. The quality of works of Muvattupuzha division of Muvattupuzha Valley Irrigation project is checked by the Muvattupuzha Quality Control Section. The quality works under taken by the Piravam Division of Muvattupuzha Valley Project is done by the Koothattukulam Quality Control Section. Quality Control Section Angamaly is checking the quality of works undertaken by the Angamaly Division and Chalakudy Division of Idamalayar Irrigation Project. Two laboratories at Koothattukulam and Angamaly are functioning with nominal equipments for this purpose.

6. Division office at Thrissur

Apart from compiling monthly and quarterly inspection reports received from the five Subdivisions, comparing test results with IS and other approved standards, recommending necessary suggestion if any are the duties of Division office. Random inspections of major and important woks are to be done by the Division office.

Duties of the Division office also include effective coordination and supervision of these Sub divisions which have such a vast area of operation in the field of quality maintenance of works under Irrigation Department and smooth functioning of the day to day activities such as personnel and official needs of the staff of the sub divisions, especially at the present scenario of introducing the new scheme ‘Modernization of Quality Control Wing’.

Present functional activities of the Division and Sub divisions

Apart from inspections conducted by the Quality Control sections and Quality Control Sub Division offices, random inspection in major and important works are also being conducted by the Division Office. Irregularities noticed are brought into the notice of the execution wing with clear direction to rectify the same.

One of the major projects coming under WRD is Dam Rehabilitation and Improvement Project (DRIP) of major dams of Kerala. Since 2013, the wing is engaged in the Quality Control testing of DRIP works also. DRIP is implementing with financial assistance of World Bank. As per the direction of the Chief Engineer (I & D) IDRB, we are participating in the discussions conducted by CWC Consultant at DRIP sites. As per the norms of DRIP, KWRD is to conduct timely inspection and certify the quality of work executed under the projects.

The list of dams that are coming under the Dam Rehabilitation and Improvement Project (DRIP) are as follows.

Sl. No.	DAM	Name of District
1	Pothundy	Palakkad
2	Malankara	Muvattupuzha
3	Vazhani	Thrissur
4	Peechi	Thrissur
5	PeriyarVallyBerrage	Ernakulam
6	Chulliar	Palakkad
7	Meenkara	Palakkad
8	Walayar	Palakkad
9	Pazhassi	Kannur
10	Kanhirapuzha	Palakkad
11	Chimoni	Thrissur
12	Kuttiadi	Kozhikode
13	Malampuzha	Palakkad
14	MoolatharaRegulater	Palakkad (Chitturpuzha)

As part of modernization of quality control wing, setting up of full-fledged laboratories with most modern equipments and machineries, mobile quality control unit etc., is in progress. Details of Modernization works are as follows.

Sl. No.	Financial Year	Name of Work	Head of Account	Estimate PAC	Remarks
1	Spill over works from previous years	Modernization of Quality Control Wing – Phase I at Kozhikode AS – G.O.(Rt)No. 801/2015/WRD dt. 22.09.2015.	2701-80-005-97-00-00-V (Investigation and Design)	65,53,000/-	Works completed. Bill submitted in EMLI for payment.
2	-do-	Modernization of Quality Control Wing – Phase II at Palakkad FS – No. QCD TSR/2016/400/IDRB dt. 18.03.2017. AS – No. QCD TSR/2016/400/IDRB dt. 30.03.2017.	2701-80-005-97-00-00-V (Investigation and Design)	23,81,800/-	Works completed. Bill submitted in EMLI for payment
3	-do-	Modernization of Quality	2701-80-005-93-	43,30,000/-	Work in

		Control Wing –Phase III at Thrissur FS – QCD/TSR/2017/110/IDRB dt. 29.09.2017 AS – QCD TSR/2017/110/IDRB dt. 01.03.2018	00-00-V (Modernization of Design wing)		progress.

Annual maintenance for Lab equipments,Calibration charge for Compression Testing Machine (CTM),Routine works for Quality Control Lab,Hiring Charge Vehicle for sample collection, Procurement of Computer and accessories for Thrissur and Kannur Sub Division offices were included for Rs.6,00,000/- for the financial year 2019-20.

Inspection conducted:

Sl. No.	Name of Sub Division	Number of Inspections conducted.
1	Quality Control Sub Division, Palakkad	288 Nos.
2	Quality Control Sub Division, Muvattupuzha	254 Nos.
3	Quality Control Sub Division, Thrissur	407Nos.
4	Quality Control Sub Division, Kozhikode	106 Nos.
5	Quality Control Sub Division, Kannur	124 Nos.

Formulation of Quality Control Manual

Since there is no Quality Control Manual in our department initiatives have been taken for the formulation of the same. Even though PWD Quality Control Manual is currently followed, separate manual for Irrigation Department is essential as the conditions and nature of water retaining structures are entirely different from other structures like buildings, roads, bridges etc. The work has been entrusted with Quality Control Sub Division Thrissur and sanction for the same has been accorded as follows.

Name of work	Irrigation Department – Preparation of Irrigation Quality Control Manual 2018.
Head of Account	2701-80-005-93-00-00-V (Modernization of design wing)
Financial Sanction	Order No. QCDTsr/2018/246/IDRB Dt. 30.01.2019.
Administrative Sanction	Order No. QCDTsr/2018/246/IDRB Dt. 27.02.2019.
Technical Sanction	Order No. QCDTsr/2018/246/IDRB Dt. 03.03.2019.
TS Amount	3,50,000/-

Budget Allotments and expenditure

No separate budget allocation to the Quality control Wing. The needs of this division is met with the provisions allotted under the head of account 2701-80-005-97 & 2701-80-005-93 Investigation & Design under Plan and from 2701-80-004-96 for Non Plan wing. Budget allotments for Plan and Non Plan heads of accounts for the last 3 years are as follows

(i) Budget allotment

Plan / Non Plan	Heads of A/c	2019-20
Plan (for IDRB)	2701-80-005-97	Nil
	2701-80-005-93For Modernization of Design wing	150 lakhs (only 6 lakhs sanctioned to this division)
Non Plan(For Thrissur and Kottarakara Quality Control Divisions)	2701-80-004-96	1251.08 lakhs

(ii)Expenditure (For Thrissur Division only)

Plan / Non Plan	Heads of A/c	2019-20
Plan	2701-80-005-97	Nil
	2701-80-005-93	Nil
Non Plan	2701-80-004-96	658.83 lakhs

Present staff strength

1. Thrissur Sub Division

Sl. No.	Category	Sanctioned strength	Existing strength	Vacancy	Remarks
1	Asst. Exe. Engineer	1	1	0	
2	Asst. Engineer	2	2	0	
3	1st Grade D'man	1	1	0	
4	2nd Grade D,man	3	2	1	
5	3rd Grade D'man	3	3	0	
6	Head Clerk	1	1	0	
7	Senior Clerk/Junior Clerk	2	2	0	
8	Typist	1	1	0	
9	Driver	1	0	1	
10	Office Attendant	2	2	0	
11	Lascar	2	1	1	
12	Part Time Sweeper	1	1	0	
13	Total	**20**	**17**	**3**	

2.Palakkad Sub Division

Sl. No.	Category	Sanctioned strength	Existing strength	Vacancy	Remarks
1	Asst. Exe. Engineer	1	1	0	
2	Asst. Engineer	2	2	0	
3	1st Grade D'man	1	1	0	
4	2nd Grade D,man	3	3	0	
5	3rd Grade D'man	2	2	0	
6	Head Clerk	1	1	0	
7	Senior Clerk/Junior Clerk	3	3	0	
8	Typist	1	1	0	
9	Driver	1	0	1	
10	Office Attendant	1	1	0	
11	Lascar	2	0	2	
12	Part Time Sweeper	1	1	0	
13	Total	**19**	**16**	**3**	

3. Kozhikkode Sub Division

Sl. No.	Category	Sanctioned strength	Existing strength	Vacancy	Remarks
1	Asst. Exe. Engineer	1	1	0	
2	Asst. Engineer	2	1	1	
3	1st Grade D'man	1	0	1	
4	2nd Grade D,man	2	2	0	
5	3rd Grade D'man	3	3	0	
6	Head Clerk	1	1	0	
7	Senior Clerk/Junior Clerk	2	2	0	
8	Typist	1	1	0	
9	Driver	1	0	1	
10	Office Attendant	2	2	0	
11	Lascar	2	1	1	
12	Part Time Sweeper	1	1	0	
13	Total	19	15	4	

4. Kannur Sub Division

Sl. No.	Category	Sanctioned strength	Existing strength	Vacancy	Remarks
1	Asst. Exe. Engineer	1	1	0	
2	Asst. Engineer	2	0	2	
3	1st Grade D'man	2	1	1	
4	2nd Grade D,man	0	0	0	
5	3rd Grade D'man	2	2	0	
6	Head Clerk	1	1	0	
7	Senior Clerk/Junior Clerk	3	3	0	
8	Typist	1	1	0	
9	Driver	1	0	1	
10	Office Attendant	2	2	0	
11	Lascar	0	0	0	
12	Part Time Sweeper	0	0	0	
13	Total	15	11	4	

5. Muvattupuzha Sub Division

Sl. No.	Category	Sanctioned strength	Existing strength	Vacancy	Remarks
1	Asst. Exe. Engineer	1	1	0	
2	Asst. Engineer	3	2	1	
3	1st Grade D'man	2	2	0	
4	2nd Grade D,man	3	3	0	
5	3rd Grade D'man	3	3	0	
6	Head Clerk	1	1	0	
7	Senior Clerk/Junior Clerk	3	3	0	
8	Typist	2	1	1	
9	Driver	1	0	1	
10	Office Attendant	3	2	1	
11	Lascar	0	0	0	
12	Worker	1	1	0	
13	Part Time Sweeper	0	0	0	
14	Total	23	19	4	

6. Division

Sl. No.	Category	Sanctioned strength	Existing strength	Vacancy	Remarks
1	Exe. Engineer	1	1	0	
2	Asst. Exe.Engineer/Tech. Asst.	1	1	0	
3	1st Grade D'man	1	1	0	
4	2nd Grade D,man	2	1	1	
5	Blue Printer	1	1	0	
6	Divisional Accountant	1	0	1	
7	Junior Supdt	2	1	1	
8	Senior Clerk/Junior Clerk	8	7	1	
9	Typist	1	1	0	
10	Office Attendant	3	3	0	
11	Watchman	1	1	0	
12	Part Time Sweeper	1	1	0	
13	Total	23	19	4	

*The sanctioned strength given above is as per GO(Rt.)50/2015/WRD Dated: 19.1.2015& GO(MS) No. 12/2018/WRD Dated: 20-01-2018

QUALITY CONTROL DIVISION,KOTTARAKKARA

1. Introduction

ഇറിഗേഷൻ ക്വാളിറ്റി കൺട്രോൾ ഡിവിഷൻ, കൊട്ടാരക്കര

ഇറിഗേഷൻ ക്വാളിറ്റി കൺട്രോൾ ഡിവിഷൻ, കൊട്ടാരക്കരയുടെ അധികാരപരിതി തിരുവനന്തപുരം, കൊല്ലം, ആലപ്പുഴ, പത്തനംത്തിട്ട, കോട്ടയം, ഇടുക്കി എന്നീ ആറ് ജില്ലകളിലായി വ്യാപിച്ചുകിടക്കുന്നു. ഈ ജില്ലകളിലെ ജലസേചന വകുപ്പിൻ കീഴിലുള്ള പ്രവൃത്തികളുടെ കൃത്യമായ ഗുണനിലവാരം പരിശോധിച്ച് ഉറപ്പ് വരുത്തുന്നതിന് വേണ്ടിയാണ് ഈ കാര്യാലയം രൂപികരിച്ചിട്ടുള്ളത്.

നിലവിൽ ഇറിഗേഷൻ ക്വാളിറ്റി കൺട്രോൾ ഡിവിഷൻ, കൊട്ടാരക്കര കാര്യാലയത്തിന് കീഴിൽ തിരുവനന്തപുരം, കൊട്ടാരക്കര, ആലപ്പുഴ, കോട്ടയം എന്നി നാല് സബ് ഡിവിഷനുകളും അവയ്ക്ക് കീഴിൽ തിരുവനന്തപുരം, കൊല്ലം, കൊട്ടാരക്കര, ആലപ്പുഴ, പത്തനംത്തിട്ട, കോട്ടയം, ഇടുക്കി എന്നീ ഏഴ് സെക്ഷൻ ഓഫീസുകളും പ്രവർത്തിക്കുന്നു. ജലസേചന പ്രവൃത്തികളുടെ സ്ഥലങ്ങളിൽ പര്യവേക്ഷണം ഗുണനിലവാരം മുതലായവ, പരിശോധന അസിസ്റ്റന്റ് എക്സിക്യൂട്ടീവ് എഞ്ചിനീയർമാരുടെ മേൽ നോട്ടത്തിൽ നടത്തപ്പെടുകയും അവയുടെ റിപ്പോർട്ട് ഈ കാര്യാലയത്തിൽ സമർപ്പിക്കുകയും ചെയ്യുന്നു. പ്രസ്തുത റിപ്പോർട്ട് ഈ കാര്യാലയത്തിൽ വിശദമായി പരിശോധിക്കുകയും ന്യുനതകളുണ്ടെങ്കിൽ പ്രവൃത്തികൾ നടത്തപ്പെടുന്ന ഡിവിഷനുകളോടു ആവശ്യമായ പരിഹാര നടപടികൾ സ്വീകരിക്കുവാൻ ആവശ്യപ്പെടുകയും ചെയ്യുന്നു. കൂടാതെ വൻകിട പദ്ധതികളും, പ്രധാനപ്പെട്ടതുമായ പ്രവൃത്തികളിൽ റാന്റം പരിശോധന ഡിവിഷൻ ഓഫീസ് നേരിട്ട് നടത്തുന്നു. നിലവിൽ ഗുണനിലവാര

പരിശോധനയ്ക്കായി മറ്റ് സ്ഥാപനങ്ങളെയാണ് ആശ്രയിക്കുന്നത്, സ്വന്തമായി ഗുണനിലവാര പരിശോധന നടത്തുന്നതിനായി എല്ലാ സബ് ഡിവിഷന്റെ അധീനതയിലും ക്വാളിറ്റി കൺട്രോൾ ലാബ് നിർമ്മിക്കുന്നതിനുള്ള പ്രവർത്തനങ്ങൾ നടന്നുവരുന്നു. കൊട്ടാരക്കര ക്വാളിറ്റി കൺട്രോൾ സബ് ഡിവിഷനു കീഴിലുള്ള ലാബ് കെട്ടിടത്തിന്റെ പണി ഇതിനോടകം തന്നെ പൂർത്തികരിച്ചിട്ടുണ്ട്.

ക്വാളിറ്റി കൺട്രോൾ സബ് ഡിവിഷൻ, തിരുവനന്തപുരം

ക്വാളിറ്റി കൺട്രോൾ സബ് ഡിവിഷൻ, തിരുവനന്തപുരത്തിന്റെ കീഴിൽ തിരുവനന്തപുരത്തും കൊല്ലത്തുമായി**രണ്ട്** സെക്ഷനുകൾ പ്രവർത്തിക്കുന്നു. തിരുവനന്തപുരം കൊല്ലം എന്നീ ജില്ലകളിലെ ഇറിഗേഷൻ പ്രവർത്തികളുടെ ഗുണനിലവാരം ഉറപ്പ് വരുത്തുകയാണ് ഈ കാര്യാലയങ്ങളുടെ പ്രധാന ചുമതല. 2019-20 കാലഘട്ടത്തിൽ 83 പ്രവൃത്തി സ്ഥലങ്ങളിൽ പരിശോധന നടത്തുകയും 72 കോൺക്രീറ്റു ക്യൂബ് സാമ്പിളുകൾ ശേഖരിക്കുകയും ഇതിൽ 55 സാമ്പിളുകളുടെ കംപ്രസീവ് സ്ട്രെങ്ത് പരിശോധന ഫലം ഈ കാര്യാലയത്തിൽസമർപ്പിക്കുകയും ചെയ്തിട്ടുണ്ട്. കൂടാതെ വാമനപുരം വി.ഐ.പി പ്രോജക്ട് ഡിവിഷൻ ക്യാമ്പസിൽ ക്വാളിറ്റി കൺട്രോൾ ലാബ് നിർമ്മിക്കുന്നതിനും ഓഫീസ് അവിടെയ്ക്ക് മാറ്റുന്നതിനും വേണ്ട പ്രവർത്തനങ്ങൾ പുരോഗമിക്കുന്നു. ഇതിനായി 97,75,000/- രൂപ വാർഷിക പദ്ധതിയിൽ ഉൾപ്പെടുത്തുന്നതിനായി സമർപ്പിച്ചിട്ടുണ്ട്.

Construction of Dam Safety Head Quarters at PMG- Thiruvananthapuram

ക്വാളിറ്റി കൺട്രോൾ സബ് ഡിവിഷൻ, കൊട്ടാരക്കര

കൊട്ടാരക്കര ക്വാളിറ്റി കൺട്രോൾ സബ് ഡിവിഷൻ ഓഫീസ് കല്ലട ഇറിഗേഷൻ പ്രോജക്ടിന്റെ കീഴിലുള്ള ജോലികളുടെ ഗുണനിലവാര പരിശോധനകൾ നടത്തുന്നു. ഈ സബ് ഡിവിഷന്റെ കീഴിൽ ഒരു സെക്ഷൻ ഓഫീസ് പ്രവർത്തിച്ചു വരുന്നു. കല്ലട ഇറിഗേഷൻ പ്രോജക്ടിന്റെ കീഴിലുള്ള കാര്യാലയങ്ങളിലെ നിർമ്മാണ സാമഗ്രികളായ മെറ്റൽ, മണൽ എന്നിവയുടേയും ഗുണനിലവാര പരിശോധന സെക്ഷൻ ഓഫീസിൽ നടത്തുകയും അതിന് വേണ്ട നിർദ്ദേശങ്ങൾ നൽകുകയുമാണ് ഈ ഓഫീസിന്റെ ചുമതല. പ്രധാനപ്പെട്ട പ്രവർത്തികൾ കല്ലട ഇറിഗേഷന്റെ ഇടതുകര വലതുകര കനാലുകളുടെ ലൈനിംങ്ങ് ജോലികളുടെയും പാർശ്വഭിത്തിനിർമ്മാണങ്ങളുടേയും കോൺക്രീറ്റ് ഗുണനിലവാര പരിശോധന നടത്തുകയെന്നതാണ്.

2019-20 സാമ്പത്തിക വർഷത്തിൽ 95 എണ്ണം ഇന്റിമേഷനുകൾ ലഭിക്കുകയും 94 ഇൻസ്പെക്ഷനുകൾ നടത്തുകയും 20 കോൺക്രീറ്റ് സാമ്പിളുകൾ ശേഖരിക്കുകയും ചെയ്തിട്ടുണ്ട്. 9 കോൺക്രീറ്റ് സാമ്പിളുകളുടെ കംപ്രസീവ് സ്ട്രെങ്ങ്ത് റിസൽട്ട് സമർപ്പിച്ചിട്ടുള്ളതും ബാക്കി എഞ്ചിനിയറിംങ്ങ് കോളേജുകളിൽ നിന്ന് ലഭ്യമാകാനുണ്ട്.

കൊട്ടാരക്കര കെ.ഐ.പി രവിനഗർ കാമ്പസിൽ നിലവിലുണ്ടായിരുന്ന റിക്രിയേഷൻ ക്ലബ് കെട്ടിടം ലിന്റൽ ലെവൽ മുതൽ പുനർനിർമ്മാണം നടത്തിയാണ് കൊട്ടാരക്കര സബ് ഡിവിഷന്റെ ക്വാളിറ്റി കൺട്രോൾ ലാബ് 2019 ഒക്ടോബറിൽ ഇരുപത്തിമൂന്ന് ലക്ഷത്തിയിരുപതിനായിരിയം രൂപ ചെലവാക്കി പൂർത്തികരിച്ചു.ഇലക്ട്രിഫിക്കേഷൻ ജോലികൾക്കും മറ്റും 2.35ലക്ഷം രൂപയും കംപ്രഷൻ ടെസ്റ്റിംങ്ങ്മെഷിൻ സ്ഥാപിക്കുന്നതിന് 7.10 ലക്ഷം രൂപയ്ക്കും 2019 മാർച്ചിൽ ഭരണാനുമതി ലഭിച്ചിട്ടുള്ളതുമാണ്. നിർമ്മാണംപൂർത്തിയായ ലാബിന്റെ ഫോട്ടോയും ഇതോടൊപ്പം ചേർക്കുന്നു.

ക്വാളിറ്റി കൺട്രോൾ സബ് ഡിവിഷൻ, ആലപ്പുഴ

1995ൽ പ്രവർത്തനമാരംഭിച്ച ഈ കാര്യാലയത്തിന് കീഴിൽ ആലപ്പുഴ ജില്ലയിലും പത്തനംതിട്ട ജില്ലയിലുമായി **രണ്ട്** സെക്ഷൻ ഓഫീസുകൾ പ്രവർത്തിക്കുന്നു. ആലപ്പുഴ, പത്തനംത്തിട്ട എന്നീ ജില്ലയിലെ ജലവിഭവ വകുപ്പിന്റെ കീഴിലുള്ള എല്ലാ കാര്യാലയങ്ങളിലും നടത്തപ്പെടുന്ന നിർമ്മാണ പ്രവർത്തികളുടെയും നിർമ്മാണ സാമഗ്രികളുടെയും ഗുണനിലവാര പരിശോധന ഈ കാര്യാലയത്തിൻ കീഴിലാണ്. ഈ **രണ്ട്** സെക്ഷൻ ഓഫീസുകളും ശേഖരിക്കുന്ന സാമ്പിളുകളായ മെറ്റൽ, മണൽ എന്നിവ ആലപ്പുഴ ക്വാളിറ്റി കൺട്രോൾ സബ് ഡിവിഷൻ ഓഫീസിൽ നൽകുകയും അവിടെ നിന്ന് സീവ് അനാലിസിസ് നടത്തി റിസൽട്ട് പ്രവൃത്തികൾ നടത്തുന്ന ഡിവിഷൻ ഓഫീസുകളിലേക്ക് നല്കുകയുമാണ് ചെയ്തു വന്നിരുന്നത്. എന്നാൽ 2019 ഡിസംബറോടുകൂടി സീവ് അനാലിസിസ് അതാതു സെക്ഷൻ ഓഫീസുകളിൽ തന്നെ നടത്തുവാനുള്ള ക്രമീകരണങ്ങൾ നടപ്പിലാക്കുകയും ചെയ്തു. നിലവിൽ സബ് ഡിവിഷനിലു**ണ്ട**ായിരുന്ന സീവിംഗ് സെറ്റ് ആലപ്പുഴ ക്വാളിറ്റി കൺട്രോൾ സെക്ഷനു കൈമാറി. പത്തനംതിട്ട ഇറിഗേഷൻ ക്വാളിറ്റി കൺട്രോൾ സെക്ഷനു പുതിയ സിവിംഗ് സെറ്റ് തനതു വർഷം വാങ്ങുകയു**ണ്ട**ായി.

2019-20 സാമ്പത്തിക വർഷം 329 ജോലികളുടെ അറിയിപ്പുകൾ ലഭിക്കുകയും 288പരിശോധനകൾ നടത്തി റിപ്പോർട്ടുകൾ സമർപ്പിയ്ക്കുകയും ചെയ്തു. ഇത് മുൻ വർഷങ്ങളെക്കാൾ കൂടുതൽ പരോഗതിയിൽ എത്താൻ സാധിച്ചു.

ഈ സബ് ഡിവിഷന്റെ കീഴിൽ സ്വന്തമായി ഒരു ലാബ് നിർമ്മിക്കാനുള്ള പദ്ധതി സ്ഥലം കൈമാറുന്നതിനുള്ള സാങ്കേതിക തടസ്സം മൂലം നടപ്പിലാക്കാൻ സാധിച്ചിട്ടില്ല. ഈ കാര്യാലയത്തിന് കീഴിൽ സ്വന്തമായി ലാബ് നിർമ്മിക്കുന്നതിന് മറ്റൊരു അനുയോജ്യമായ സ്ഥലം ക**ണ്ട**ത്തി പ്രവർത്തനങ്ങൾ തുടങ്ങാൻ ആഗ്രഹിക്കുന്നു.

പത്തനംതിട്ട ക്വാളിറ്റി കൺട്രോൾ സെക്ഷന്റെ സീവ് അനാലിസിസ്

പത്തനംതിട്ട ക്വാളിറ്റി കൺട്രോൾ സെക്ഷന്റെ കീഴിലുള്ള ഒരു കോൺക്രീറ്റ്

ആലപ്പുഴ ക്വാളിറ്റി കൺട്രോൾ സെക്ഷന്റെ സീവ് അനാലിസിസ്

ആലപ്പുഴ ക്വാളിറ്റി കൺട്രോൾ സെക്ഷന്റെ കീഴിലുള്ള ഒരു കോൺക്രീറ്റ്ക്യൂബ് നിർമ്മാണം

പി.ഐ.പി. സെക്ഷൻ നം. 10

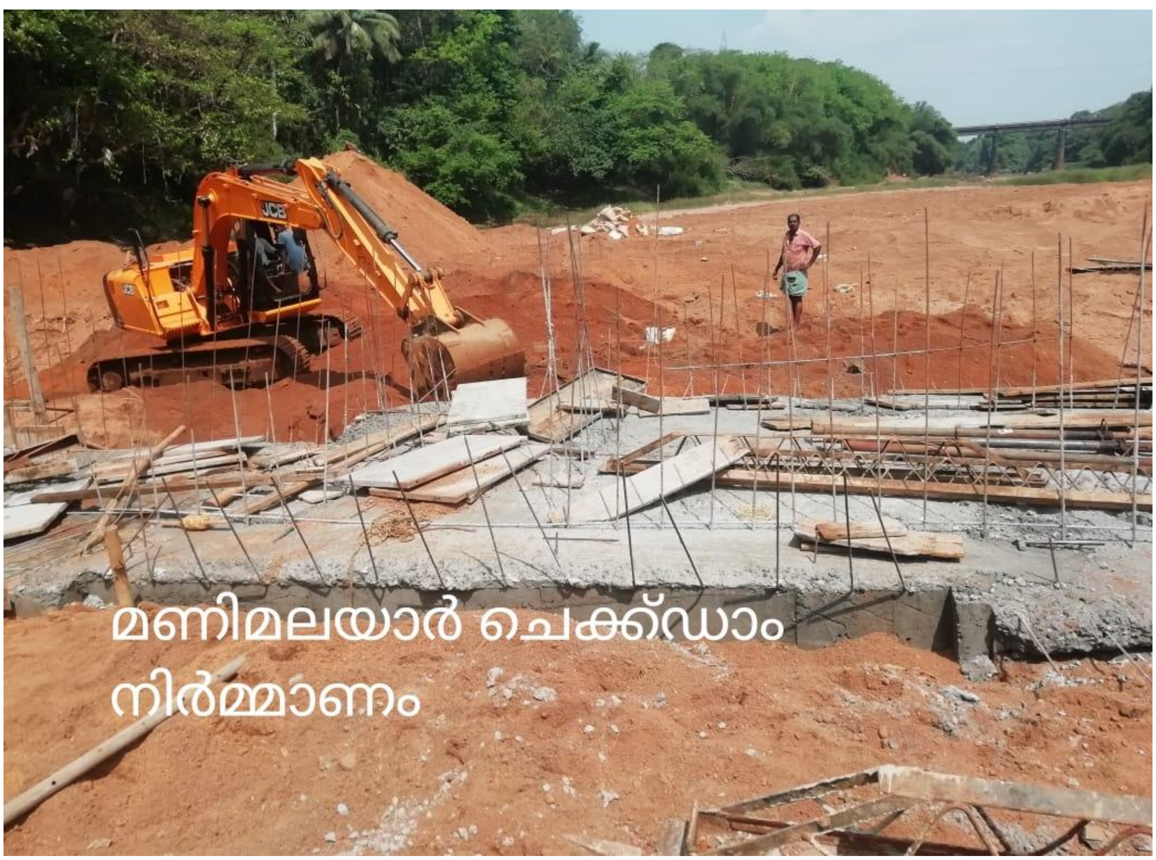
ക്വാളിറ്റി കൺട്രോൾ സബ് ഡിവിഷൻ, കോട്ടയം

ഈ സബ്ഡിവിഷന്റെ കീഴിൽ, കോട്ടയം ജില്ലയിലെ വിവിധ നിർമ്മാണ പ്രവർത്തനങ്ങളുടെ ഗുണനിലവാര പരിശോധന ചെയ്യുന്നതിനായി കോട്ടയത്ത് ഒരു സെക്ഷൻ ആഫീസും, ഇടുക്കി ജില്ലയിലെ നിർമ്മാണ പ്രവർത്തനങ്ങളുടെ ഗുണനിലവാര പരിശോധനയ്ക്കായി ഇടുക്കി ജില്ലയിൽ മുട്ടത്ത് ഒരു സെക്ഷൻ ആഫീസും പ്രവർത്തിച്ചു വരുന്നുണ്ട്. 2019-20 സാമ്പത്തിക വർഷത്തിൽ ഈ ഓഫീസിന്റെ കീഴിൽ 137 സൈറ്റ് ഇൻസ്പെക്ഷൻസ് നടത്തുകയുണ്ടായി. ഇതിൽ 110 പ്രവൃത്തികളുടെ ടെസ്റ്റ് റിസൾട്ട് ലഭിച്ചിട്ടുണ്ട്. എഞ്ചിനിയറിംഗ് കോളേജുകളിൽ നിന്ന് ഏതാനും റിസൽട്ട് ലഭ്യമാകാനുണ്ട്. ഇടുക്കി ജില്ലയിലെ മറയൂരിൽ നിർമ്മാണത്തിലുള്ള പട്ടിശ്ശേരി ഡാമിന്റെ ഗുണനിലവാര പരിശോധന അവിടെ തന്നെ സജ്ജമാക്കിയിരിക്കുന്ന ലാബിൽ ടെസ്റ്റ് ചെയ്തുവരുന്നു. ഡാമിന്റെ ഫൗണ്ടേഷൻ ഗ്രൗട്ടിംഗും, ഫൗണ്ടേഷൻ കോൺക്രീറ്റിംഗും പൂർത്തിയാക്കിയിട്ടുണ്ട്.

സ്വന്തമായി ലാബ് ഇല്ലാത്തതിനാൽ ടെസ്റ്റിംഗിന് പുറത്തുള്ള ഇൻസ്റ്റിറ്റ്യൂഷനുകളെ ആശ്രയിക്കേണ്ടി വരുന്നു. തൻമൂലം റിസൽട്ടുകൾ ലഭിക്കാൻ ചിലസമയങ്ങളിൽ കാലതാമസവും ഉണ്ടാകാറുണ്ട്.

ഈ സബ്ഡിവിഷന്റെ കീഴിൽ ഇടുക്കി സെക്ഷനിൽ മുട്ടത്ത് എം.വി.ഐ.പി യുടെ സ്ഥലത്ത് ഒരു ക്വാളിറ്റി കൺട്രോൾ ലാബ് പുതിയതായി നിർമ്മിക്കുന്നതിനും, ആവശ്യമായ മെഷിനറികളും കമ്പ്യൂട്ടറുകളും വാങ്ങിക്കുന്നതിനുമായി മൊത്തം 86,00,000/-രൂപയുടെ എസ്ററിമേറ്റ് സാമ്പത്തിക അനുമതിയ്ക്കായി സമർപ്പിച്ചിട്ടുണ്ട്. സർക്കാർ അനുമതി ലഭിക്കുന്ന മുറയ്ക്ക് തുടർനടപടികൾ കൈക്കൊള്ളാവുന്നതാണ്.

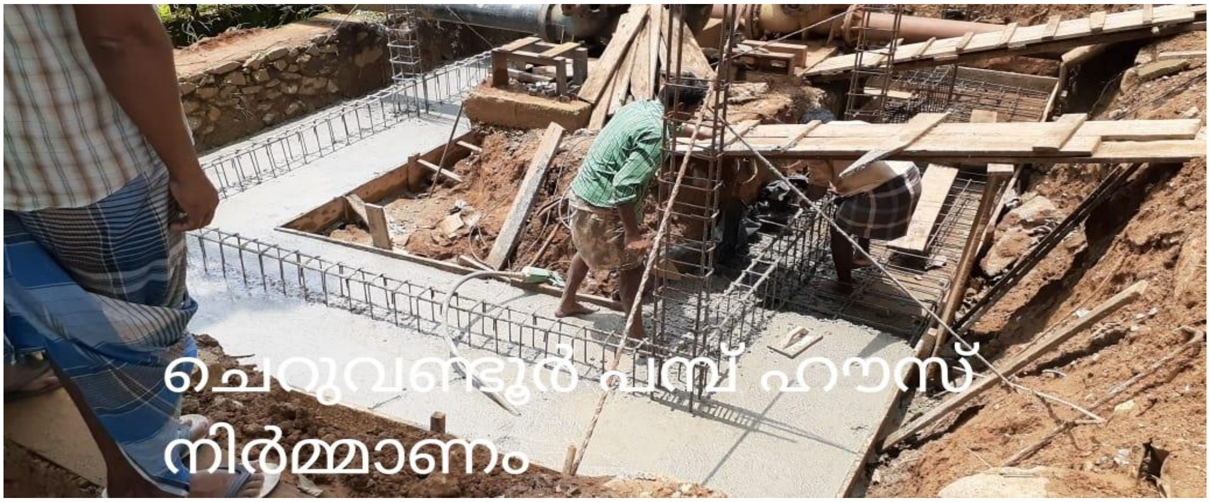

മാഞ്ഞൂർ പഞ്ചായത്ത് മോട്ടോർ
തറ നിർമ്മാണം


മണിമലയാർ ചെക്ക്ഡാം
നിർമ്മാണം


മുണ്ടൂപാല ചെക്ക്ഡാം
നിർമ്മാണം


പന്നഗം തോട് ചെക്ക്ഡാം
നിർമ്മാണം


മീനച്ചിൽ പുഴ സംരക്ഷണഭിത്തി
നിർമ്മാണം



ഇടുക്കി സെക്ഷൻ


02.14.2020


02.14.2020


02.14.2020


02.14.2020


02.14.2020


02.14.2020


പട്ടിശ്ശേരി ഡാം നിർമ്മാണം
പൂർത്തികരിക്കുമ്പോൾ

സംരക്ഷണ ഭിത്തി നിർമ്മാണം

മൂന്നാർ ചെക്ക്ഡാം നിർമ്മാണം – കണ്ണിമല നദി

അറയ്ക്കത്തോട് ചെക്ക്ഡാം പുനരുദ്ധാരണ പ്രവർത്തനങ്ങൾ ഉടുമ്പന്നൂർ പഞ്ചായത്ത്

മേലാടി നാഗർപള്ളം കനാൽ നിർമ്മാണം മറയൂർ പഞ്ചായത്ത്

Inspection Made & Test Conducted Under Quality Control Division, Kottarakkara 2019-20

Sl. No.	Name of Sub Division	No.of Inspection conducted	No. of Test Result	Remarks Awaiting result
1	Quality Control Sub Division, Thiruvanathapuram	83	55	72 No. Samples collected 17 Nos. awaiting result
2	Quality Control Sub Division, Kottarakkara	94	9	20 Nos. samples collected 11 Nos. awaiting result
3	Quality Control Sub Division, Alappuzha	329	288	288 Nos. samples collected, awaiting result nil
4	Quality Control Sub Division, Kottayam	137	110	137 Nos. samples collected awaiting result 27 Nos.
	Total	**643**	**462**	**55 Nos. of result awaiting**

5. FINANCE

In the budget for the financial year 2019-20 an outlay of Rs.96.50 Lakh (Rupees ninty six lakh fifty thousand only) 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.27,04,736/- (Rupees twenty seven lakh four thousand seven hundred thirty six only) 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	29lakh
2	Soil Mechanics and Foundations Division	11.5lakh
3	Instrumentation Division	29.87lakh
	Total amount received	**69.37 lakh**
	Expenditure	**27,83,460 /-**
II	**Joint Director, Hydraulic Research, KERI, Peechi.**	
1	Coastal Engineering Division	21.79 lakh
2	Hydraulics Division	15.5 lakh
3	Sedimentation Division	22.3 lakh
	Total amount received	**59.59 lakh**
	Expenditure	**35,24,378/-**

Details of Expenditure statement for the year 2019– 20 had been allotted under the Various **Head of Account are given below.**

Sl.No.	Head of Account	Division	A.S Amount	Expenditure
I	**Joint Director, C.M.&F.E., KERI, Peechi**			
1	Head of Account: 4700-80-005-99-02-00-Investigation of Major Irrigation Schemes (Plan Scheme)	Instrumentation Division	12,37,000/-	9,11,062/-
2	Head of Account: 4701-80-800-99-00-Development of KERI-Stage II	Construction Materials Division	17,50,000/-	5,49,218/-
		Soil Mechanics & Foundations Division	11,50,000/-	4,45,772/-
		Instrumentation Division	17,50,000/-	8,77,408/-
II	**Joint Director, Hydraulic Research, KERI, Peechi.**			
1	Head of Account: 4700-80-005-99-02-00-Investigation of Major Irrigation Schemes (Plan Scheme)	Coastal Engineering Division	8,42,000/-	6,38,068/-
		Sedimentation Division	3,50,000/-	3,02,598/-
2	Head of Account: 4701-80-800-99-00-Development of KERI-Stage II	Coastal Engineering Division	13,37,000/-	12,10,127/-
		Sedimentation Division	18,80,000/-	7,21,730/-
		Hydraulics Division	15,50,000/-	6,51,861/-

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/underutilizations 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 DETAILS OF TECHNICAL STAFF FOR THE MONTH OF MARCH 2020
Fundamental and Applied Research, KERI, Peechi

Sl. No.	Name of Post	Sanctioned Strength	Present Strength	Place of Vacancy
1	Director	1	1	
2	Joint Director/Executive Engineer	5	5	
3	Deputy Director/Assistant Executive Engineer	19	18	C M Divion K E R I Peechi-1
4	Assistant Director/Assistant Engineer	42	34	Quality Control Section,palakkad-1 Quality Control Section,Kasargod-1 C E Section,Thalasseri-1 C E Division,K E R I Peechi-1 Quality Control Section,Thrissur-1 Quality Control Section Kozhikkode-1 S M Division K E R I Peechi-1 C E Division K E R I Peechi-1
5	Research Assistant/1st Gr. D'man	47	42	Hydraulics Division, KERI,Peechi-1 Sedimintation Division,K E R I,Peechi-2 JD:C E F S Thrissur-2 Quality Control Sub Division Alappuzha-1 Quality Control Sub Division Kannur-1
6	2nd Grade D'man/Overseer	44	39	Quality Control Section Ernamkulam Aluva-1 Quality Control Section Kalpetta-1 C M Division K E R I Peechi-1 C E SectionThalasseri-1 Quality Control Sub Division , Kottayam-1
7	3rd Grade Overseer	31	31	
8	Scientific Assistant	2	0	Soil Mechanic Division, KERI, Peechi-1 Hydraulic Division, KERI, Peechi -1
9	Lab Attender	2	0	Construction Materials Division, KERI, Peechi-1 Hydraulic Division, KERI, Peechi -1
10	Tracer	1	1	
11	Blue Printer	2	1	Hydraulic Research, KERI, Peechi -1

Appendix – II

An abstract of the Weather data collected from Automatic Weather Station for the period from April 2019 to March 2020 is given below

Abstract of the weather data from April, 2019 to March, 2020

STATION: K.E.R.I,PEECHI

Latitude- 10^{o} 31’ 30” N Longitude- 76^{o} 21’59” E MSL- +96.03 M.

Sl.No	Weather Elements	Range of the weather data
1.	Temperature	The maximum temperature was 40.5^{o}C in March 27th-2019 and the minimum temperature was 22^{o}C in 11th December -2019
2.	Relative Humidity	The relative humidity at 8.30 AM observation time varies from 96% to 63% during the calander year 2020
3.	Precipitation	Annual rainfall was **3249.9**mm (for the calendar year 2019) and the maximum monthly rainfall was 990.3mm in August 2019 and minimum monthly rainfall 6.6mm in December 2019.During January, February, March has not obtained any rainfall.
4.	Wind-Direction	The main wind directions observed were from South East and North East directions.
5.	Wind Speed	Maximum daily mean wind speed was 11.6 km/hr in November 23rd 2019 and minimum daily mean wind speed was 0.2 km/hr in July 7th2019.
6.	Atmospheric pressure	Barometer and Automatic weather station are out of order during this period. Hence data not available.
7.	Evaporation	Maximum Evaporation was 8mm in February 2019.
8.	Sunshine Recorder	The duration of bright sunshine was 10.30 Hours to 0.0 Hours during calendar year 2020

Appendix – III

List of tests conducted in the CM laboratory

Sl. No.	**Details of tests during April 2019 - March 2020**
1	Testing of steel bars supplied by the Assistant Engineer, PWD buildings Sn, Wadakkanchery, Thrissur
2	MIX Design for the Assistant Engineer, PWD buildings Sn, Wadakkanchery, Thrissur
3	Testing of steel bars supplied by the Assistant Engineer, MI Section, Kunnamkulam.
4	Compressive strength of concrete cubes supplied by the Assistant Engineer, The Kerala State Housing Board, Thrissur.
5	Compressive strength of concrete cubes supplied by the Assistant Engineer, Quality control Sn, Thrissur.
6	Compressive strength of concrete cubes supplied by the Assistant Engineer, Quality control Sn, Thrissur.
7	Compressive strength of concrete cubes supplied by the Assistant Engineer, Quality control Sn, Thrissur
8	Compressive strength of concrete cubes supplied by the Assistant Engineer, Quality control Sn, Thrissur.
9	Compressive strength of concrete cubes supplied by the Assistant Engineer, Quality control Sn, Thrissur.
10	Compressive strength test of concrete cubes supplied by Assistant Executive Engineer, LSGD Sub section, Mathilakm Block Panchayath.
11	Compressive strength test of concrete cubes supplied by Assistant Executive Engineer, LSGD Sub section, Mathilakm Block Panchayath.

12	Compressive strength test of Solid Blocks supplied by Assistant Engineer, PWD Building section, Kunnamkulam.
13	Testing of steel bars supplied by the Assistant Engineer, MI Section, Kunnamkulam.
14	MIX Design for the Assistant Engineer, PWD buildings Sn, Kunnamkulam.
15	Compressive strength of concrete cubes supplied by the Assistant Engineer, PWD buildings Sn, Irinjalakuda
16	MIX Design for the Assistant Engineer, PWD buildings Sn, Kunnamkulam
16A	Testing of steel bars supplied by the Assistant Engineer, PWD buildings Sn, Kunnamkulam.
17	Testing of Cement supplied by the Assistant Engineer, PWD buildings Sn, Kunnamkulam
18	Compressive strength test of concrete cubes supplied by Assistant Engineer, Chimmoni dam project section, Echippara.
19	Testing of Rubber samples supplied by the Middle East Rubber & Engineering.
20	Compressive strength test of concrete cubes supplied by Assistant Engineer, KSHB, Ayyanthole, Thrissur.
21	MIX Design for the PHOENIX INFRA BUILD.
22	Compressive strength test of concrete cubes supplied by Assistant Engineer, KSHB, Ayyanthole, Thrissur.
23	Compressive strength test of concrete cubes supplied by Assistant Engineer, MI Section, Kunnamkulam.
24	Testing of steel bars supplied by the Assistant Engineer, MI Section, Chalakudy.
25	Testing of composite material by Bijith, Chalakudy.
26	Compressive strength test of concrete cubes supplied by DENNY, QUALITY

	CONTROL
27	Compressive strength test of concrete cubes supplied by the Project Manager, Nirmithi Kendra, Ayyanthole, Thrissur.
28	Compressive strength test of concrete cubes supplied by Assistant Engineer, KSHB.
29	Compressive strength test of concrete cubes supplied by Assistant Engineer, KSHB.
30	Testing of steel bars supplied by the Assistant Engineer, Quality Control Section, Thrissur.
31	Testing of Coarse aggregates supplied by Assistant Engineer, KITCO Limited.
32	Testing of Fine aggregates supplied by Assistant Engineer, KITCO Limited.
33	Testing of cement supplied by the Assistant Engineer, KITCO Limited.
34	MIX Design for the work of Pattissery Dam.
35	MIX Design for the work of Pattissery Dam
36	MIX Design for the work of Pattissery Dam.
37	MIX Design for the work of Pattissery Dam.
38	MIX Design for the work of Pattissery Dam.
39	MIX Design for the work of Pattissery Dam
40	Testing of steel by AE KSHB, Thrissur
41	Testing of cement supplied by the Assistant Engineer, CPWD, THRISSUR.
42	Compressive strength test of concrete cubes supplied by Assistant Engineer, Quality Control Section, Thrisur..
43	Compressive strength test of concrete cubes supplied by Assistant Engineer, Quality Control Section, Thrisur,

44	Compressive strength test of concrete cubes supplied by Assistant Engineer, Quality Control Section, Thrisur.
45	Compressive strength test of concrete cubes supplied by Assistant Engineer, Quality Control Section, Thrisur
46	Compressive strength test of concrete cubes supplied by Assistant Engineer, Quality Control Section, Thrisur
47	Compressive strength test of concrete cubes supplied by Assistant Engineer, Quality Control Section, Thrisur.
48	Compressive strength test of concrete cubes supplied by Assistant Engineer, KSHB
49	Testing compressive strength of Rock samples by AE, Pampar Project Section, Marayoor.
50	Compressive strength of concrete cubes supplied by the Assistant Engineer, AE, LSGD, Mathilakam.
51	Compressive strength test of concrete cubes supplied by Assistant Engineer, KSHB.
52	Compressive strength of Concrete cubes supplied by the Power Grid Corporation, Kozhikode.
53	MIX Design for the work of CPWD, Thrissur.
54	Tests on Fly ash bricks by CPWD, Thrissur
55	Testing of cement supplied by the CPWD, Thrissur.
56	Testing compressive strength of concrete cubes by Project Manager, District Nirmithikendra, Ayyanthole, Thrissur.
57	Tests on steels by the CPWD, Thrissur
58	Sight Specific Siesmic studies of Attapady
59	Testing of Vitrified tiles by Mr. Aravind, Prism Johnson Ltd.

60	Tests on cement by the CPWD, Thrissur.
61	Compressive strength test of concrete cubes supplied by Assistant Engineer, Quality Control Section, Thrisur.
62	Compressive strength test of concrete cubes supplied by Assistant Engineer, Quality Control Section, Thrisur
63	Compressive strength test of concrete cubes supplied by Assistant Engineer, Quality Control Section, Thrisur.
64	Compressive strength test of concrete cubes supplied by Assistant Engineer, Quality Control Section, Thrisur
65	Compressive strength test of concrete cubes supplied by Assistant Engineer, Quality Control Section, Thrisur.
66	Testing compressive strength of concrete cubes supplied by A.Ex.E, KSEB, Chalakudy.
67	Testing compressive strength of Rock samples by ALbero Counsel Pvt. Ltd, Vaduthala Kochi.
68	Testing compressive strength of concrete cubes by AE, MI Section, Kunnamkulam
69	Testing compressive strength of concrete cubes by Project Manager, District Nirmithi kendra, Ayyanthole, Thrissur.
70	Testing compressive strength of Concrete cubes supplied by the Ceecon Ready Mix Concrete, Kunnambathur, Pudukad.
71	Testing compressive strength of Concrete cubes supplied by the Ceecon Ready Mix Concrete, Kunnambathur, Pudukad.
72	Compressive strength of Concrete cubes supplied by the Power Grid Corporation, Kozhikode.
73	Compressive strength of Concrete cubes supplied by the Power Grid Corporation, Kozhikode.

74	Testing compressive strength of concrete cubes by AE, MI Section, Kunnamkulam.
75	Compressive strength of Concrete cubes supplied by the Power Grid Corporation, Kozhikode
76	Compressive strength of Concrete cubes supplied by the Power Grid Corporation, Kozhikode
77	Compressive strength of Concrete cubes supplied by the Power Grid Corporation, Kozhikode
78	Compressive strength of Concrete cubes supplied by the Power Grid Corporation, Kozhikode.
79	Testing compressive strength of concrete cubes supplied by the Assistant Engineer, PWD Building Section-2, Ayyanthole, Thrissur
80	Testing compressive strength of concrete cubes supplied by the Assistant Engineer, PWD Building Section-2, Ayyanthole, Thrissur.
81	Testing compressive strength of concrete cubes supplied by the Assistant Engineer, PWD Building Section-2, Ayyanthole, Thrissur.
82	Tests on ID –Road block samples supplied by Power Grid Corporation, Kozhikode.
83	Tests on ID –Road block samples supplied by Power Grid Corporation, Kozhikode
84	Testing compressive strength of concrete cubes by Project Manager, District Nirmithi kendra, Ayyanthole, Thrissur
85	Compressive strength test of concrete cubes supplied by Assistant Engineer, KSHB.
86	MIX Design for the work of Southern Railway, Ernakulam Section
87	MIX Design for the work of CPWD, BSF CAMPUS, KAINOOR.
88	Compressive strength test of concrete cubes supplied by Assistant Engineer, Quality Control Section, Thrisur

89	Compressive strength test of concrete cubes supplied by Assistant Engineer, Quality Control Section, Thrisur.
90	Compressive strength test of concrete cubes supplied by Assistant Engineer, Quality Control Section, Thrisur.
91	MIX Design for the work by the Assistant Engineer, PWD Building Section-2, Ayyanthole, Thrissur.
92	MIX Design for the work by the Assistant Engineer, PWD Building Section-2, Ayyanthole, Thrissur
93	Testing compressive strength of solid blocks supplied by the Assistant Engineer, PWD Building Section-2, Ayyanthole, Thrissur.
94	Testing of steel supplied by the Assistant Engineer, PWD Building Section-2, Ayyanthole, Thrissur.
95	Testing compressive strength of solid blocks supplied by the Assistant Engineer, PWD Building Section-2, Ayyanthole, Thrissur.
96	Testing of steel supplied by the Assistant Engineer, PWD Building Section-2, Ayyanthole, Thrissur
97	MIX Design for the work by the Assistant Engineer, PWD Building Section, MG Kavu, Thrissur.
98	Testing of steel supplied by the Assistant Engineer, PWD Building Section, MG Kavu, Thrissur.
99	Tests on concrete cubes supplied by Assistant Engineer, PWD , Thrissur.
100	Testing of Coarse aggregates supplied by the Assistant Engineer, PWD special Building Section, MG Kavu, Thrissur.
101	Testing compressive strength of concrete cubes by Project Engineer, KM Elias Constrcutions Pvt. Ltd, Chalakudy.
102	Testing of Rock samples by Sediment soil investigation, 34/2161, Ettiruthil,

	Mamangalm, Palarivattam, P.O Kochi.
103	Testing compressive strength of concrete cubes supplied by Assistant Engineer, Quality control Sn, Thrissur
104	Testing compressive strength of concrete cubes supplied by Assistant Engineer, Quality control Sn, Thrissur.
105	Testing compressive strength of concrete cubes supplied by Assistant Engineer, Quality control Sn, Thrissur
106	Testing compressive strength of concrete cubes supplied by Assistant Engineer, Quality control Sn, Thrissur
107	Testing compressive strength of concrete cubes supplied by Assistant Engineer,PWD road section, Cherpu
108	MIX Design for the work by the Assistant Engineer, PWD Building Section, Wadakanchery
109	MIX Design for the work by the Assistant Engineer, PWD Building Section, Wadakanchery
110	Testing of vitified tiles by AE Quality control Sn, Thrissur
111	Testing of compressive strength of solid blocks by the Assistant Engineer, PWD Building Section, Wadakanchery
112	Testing of compressive strength of solid blocks by the Assistant Engineer, PWD Building Section, Wadakanchery
113	Testing of steels by the Assistant Engineer, CPWD, kainoor.
114	Testing compressive strength of concrete cubes supplied by Assistant Engineer, CPWD, Kainoor.
115	Tests on Paver blocks supplied by the AE KSHB..
116	Tests on CONCRETE CUBES supplied by the AE , CPWD, THRISSUR

117	Testing of CEMENT supplied by AE ,CPWD, THRISSUR.
118	Testing of CEMENT supplied by AE ,CPWD, THRISSUR.
119	Testing of CEMENT supplied by AE ,CPWD, THRISSUR.
120	Testing of CEMENT supplied by AE ,CPWD, THRISSUR
121	Testing of CEMENT supplied by AE ,CPWD, THRISSUR
122	Testing of CEMENT supplied by AE ,CPWD, THRISSUR.
123	Testing of compressive strength of concrete cubes, Vincent P.D, Payyappilly, Peechi.
124	Testing of compressive strength of concrete cubes by. Assistant Engineer, Irrigation Quality Control section.
125	Testing of compressive strength of concrete cubes by. Assistant Engineer, Irrigation Quality Control section.
126	Testing of compressive strength of concrete cubes by. Assistant Engineer, Irrigation Quality Control section.
127	Testing of compressive strength of concrete cubes by KITCO LTD, KOCHI
128	Testing of CEMENT by QC LAB, SOBHA LTD,TCR.
129	Testing of compressive strength of concrete cubes by. Assistant Engineer, Irrigation Quality Control section.
130	Testing of compressive strength of concrete cubes by. Assistant Engineer, Irrigation Quality Control section.
131	Testing of STRUCTUTAL STEEL Supplied by the Assistant Engineer , KSHB, Thrissur.
132	Testing of STAINLESS STEEL Supplied by the Assistant Engineer , KSHB, Thrissur.
133	Testing of compressive strength of concrete cubes by KITCO LTD, KOCHI

134	Testing compressive strength of concrete cubes supplied by the AE, LSGD SUB DIVISION, CHALAKUDY
135	Testing compressive strength of concrete cubes supplied by the AE, PWD Building Section, Kunnamkulam.
136	Testing of cement supplied by AE ,CPWD, THRISSUR.
137	Testing of cement supplied by AE ,CPWD, THRISSUR
138	Testing of cement supplied by AE ,CPWD, THRISSUR
139	Testing of cement supplied by AE ,CPWD, THRISSUR
140	Testing of cement supplied by AE ,CPWD, THRISSUR
141	Testing of cement supplied by AE ,CPWD, THRISSUR
142	Testing compressive strength of concrete cubes supplied by the Assistant Engineer, PWD Building Section, Kunnamkulam.
143	Testing of compressive strength of Fly ash bricks by Assistant Engineer, CPWD Kainoor, tcr
144	Testing of compressive strength of concrete cubes by Sainudheen Bhava, Pattikkad.
145	Testing compressive strength of concrete cubes supplied by the Assistant Engineer, PWD Building Section, Kunnamkulam
146	Testing of compressive strength of concrete cubes by the Secretary, Ollukkara labour Contract Cooperative society Ltd, Mannuthy.
147	Testing of compressive strength of Solid Blocks by the RPP INFRA PROJECTS LTD, THRISSUR
148	Testing of compressive strength of concrete cubes by. Assistant Engineer, Irrigation Quality Control section., THRISSUR
149	Testing of compressive strength of concrete cubes by. Assistant Engineer, Irrigation

	Quality Control section., THRISSUR
150	Testing of compressive strength of concrete cubes by. Assistant Engineer, Irrigation Quality Control section., THRISSUR
151	Testing of compressive strength of concrete cubes by. Assistant Engineer, Irrigation Quality Control section., THRISSUR
152	Testing of compressive strength of concrete cubes by. Assistant Engineer, Irrigation Quality Control section., THRISSUR
153	Testing of compressive strength of concrete cubes by. Assistant Engineer, KSHB, TSR
154	Testing of compressive strength of concrete cubes by. Assistant Engineer, KSHB, TSR
155	Testing of STEEL by the SHRRE SHYLAM CONTRACTING REAL ESTATE PVT LTD.
156	Testing of compressive strength of Paving Blocks by. Assistant Engineer, LSGD Section, Chazhur
157	Testing of compressive strength of concrete cubes by. Assistant Engineer, KSHB, TSR
158	Testing of stainless steel supplied by. Assistant Engineer, KSHB, TSR
159	Testing compressive strength of concrete cubes supplied by the Assistant Engineer, PWD Building Section, Kunnamkulam
160	Testing of Ceramic Glazed wall tiles supplied by. Assistant Engineer, KSHB, TSR
161	Testing of compressive strength of Concrete cubes by the RPP INFRA PROJECTS LTD, THRISSUR
162	Testing of Cement & strength of concrete cubes by. Assistant Engineer, Irrigation Project section Mannamngalm, peechi
163	Testing of Cement by The Assistant Engineer, Irrigation Project section Thanipadam peechi

164	Testing of Cement by The Assistant Engineer, Irrigation Project section Thanipadam peechi
165	Testing compressive strength of concrete cubes supplied by the Assistant Engineer, PWD Building Section, Kunnamkulam
166	Testing compressive strength of concrete cubes supplied by the Abdul Rasheed, Site Engineer, New Hotel Kottaram Regency, Arangottukkara.
167	Testing compressive strength of concrete cubes supplied by the Assistant Engineer, Quality Control section, Thrissur.
168	Testing compressive strength of concrete cubes supplied by the Assistant Engineer, Quality Control section, Thrissur.
169	Testing compressive strength of concrete cubes supplied by the Assistant Engineer, Quality Control section, Thrissur.
170	Testing of STEEL by the SHRRE SHYLAM CONTRACTING REAL ESTATE PVT LTD.
171	Testing compressive strength of concrete cubes supplied by the BEST READY MIX CONCRETE, VELAKODE, MUNDUR
172	Testing of STEEL by the VISHRAAM BUILDERS & DEVELOPERS PVT LTD
173	Testing of CEMENT by the VISHRAAM BUILDERS & DEVELOPERS PVT LTD
174	Testing of STEEL by the AE, RBC SECTION, CHALAKUDY
175	Testing of compressive strength of concrete cubes supplied by the SHRRE SHYLAM CONTRACTING REAL ESTATE PVT LTD.
176	Testing of compressive strength of concrete cubes supplied by the JOSEPH GEORGE KAYKAY EM PETRI PARK, PALAKKAD
177	Testing of stainless steel supplied by. Assistant Engineer, KSHB, TSR
178	MIX DESIGN By Assistant Engineer, Irrigation section, Irinjalakuda

179	MIX DESIGN By Assistant Engineer, Irrigation section, Irinjalakuda
180	Testing of compressive strength of concrete cubes supplied by the Site engineer, WAPCOS Limited.
181	Testing of compressive strength of concrete cubes supplied by Assistant Engineer, Irrigation section, Palakkad.
182	Testing of compressive strength of concrete cubes supplied by the Site engineer, WAPCOS Limited.
183	Testing of compressive strength of concrete cubes supplied by the Site engineer, WAPCOS Limited.
184	MIX DESIGN By Assistant Engineer, KYIP, O&M SECTION 1, Peruvannamuzhi.
185	MIX DESIGN By Assistant Engineer, KYIP, O&M SECTION 1, Peruvannamuzhi.
186	Testing of compressive strength of concrete cubes supplied by the Project specific Engineer, KITCO Limited
187	Testing of compressive strength of concrete cubes supplied by the Site engineer, WAPCOS Limited.
188	Testing compressive strength of concrete cubes supplied by the Assistant Engineer, PWD Building Section, Kunnamkulam
189	Testing of compressive strength of concrete cubes supplied by the Site engineer, WAPCOS Limited.
190	Testing of compressive strength of concrete cubes supplied by the Site engineer, WAPCOS Limited.
191	Testing of compressive strength of concrete cubes supplied by the Assistant Engineer, LSGD SECTION, THEKKUMKARA
192	Testing of compressive strength of concrete cubes supplied by the CEECON READY MIX PVT LTD

193	Testing of STEEL supplied by the Project specific Engineer, KITCO Limited
194	Testing of compressive strength of concrete cubes supplied by the ANR DESIGNERS TILES LTD. Kanjikode, Palakkad.
195	Testing of compressive strength of concrete cubes supplied by the SHRRE SHYLAM CONTRACTING REAL ESTATE PVT LTD.
196	Testing of compressive strength of concrete cubes supplied by the Site engineer, WAPCOS Limited.
197	Testing of compressive strength of concrete cubes supplied by the Site engineer, WAPCOS Limited.
198	Testing of compressive strength of concrete cubes supplied by the Site engineer, WAPCOS Limited.
199	Testing of compressive strength of concrete cubes supplied by the Site engineer, WAPCOS Limited.
200	Testing of compressive strength of concrete cubes supplied by the Site engineer, WAPCOS Limited.
201	Testing of compressive strength of concrete cubes supplied by the Site engineer, WAPCOS Limited.
202	Testing of compressive strength of Solid blocks supplied by the Site engineer, WAPCOS Limited.
203	Testing of compressive strength of Solid blocks supplied by the Site engineer, WAPCOS Limited.
204	Testing of compressive strength of concrete cubes supplied by the Site engineer, WAPCOS Limited.
205	Testing of compressive strength of concrete cubes supplied by the Team leader, WAPCOS Limited.
206	Testing of compressive strength of concrete cubes supplied by the Kottaram regency.

207	MIX DESIGN by Senior Section Engineer, P.Way, Railway
208	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
209	Testing of compressive strength of interlock tiles supplied by the AE, LSGD SECTION, Pananchery.
210	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
211	Testing of compressive strength of concrete cubes supplied by the KITCO Limited, Kochi
212	Testing of compressive strength of concrete cubes supplied by the KITCO Limited, Kochi
213	Testing of compressive strength of concrete cubes supplied by the AE, PWD Buildings, Kunnamkulam.
214	Testing of STEEL supplied by the Team leader, Central Zone, WAPCOS Limited.
215	Testing of CEMENT supplied by the Team leader, Central Zone, WAPCOS Limited.
216	Testing of STEEL supplied by the Team leader, Central Zone, WAPCOS Limited.
217	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
218	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
219	Testing of compressive strength of concrete cubes supplied by the AE, KSHB, THRISSUR
220	Testing of CEMENT supplied by the KITCO PVT LIMITED, KOCHI
221	Testing of COARSE AGGREGATES supplied by the KITCO PVT LIMITED, KOCHI

222	Testing of FINE AGGREGATES supplied by the KITCO PVT LIMITED, KOCHI
223	Testing of compressive strength of interlock tiles supplied by the AE, LSGD SECTION, Pananchery.----CANCELLED
224	Testing of compressive strength of interlock tiles supplied by the AE, LSGD SECTION, Pananchery
225	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
226	Testing of compressive strength of SOLID BLOCKS supplied by the Team leader, Central Zone, WAPCOS Limited.
227	Testing of COARSE AGGREGATES supplied by the HILITE PROJECTS PVT LTD
228	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
229	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
230	Testing of compressive strength of concrete cubes supplied by the CEECON READY MIX PVT
231	Testing of compressive strength of concrete cubes supplied by the KITCO LIMITED, KOCHI
232	Testing of AGGREGATES supplied by the CEECON READY MIX PVT
233	Testing of AGGREGATES supplied by the CEECON READY MIX PVT
234	Testing of compressive strength of concrete cubes supplied by the CEECON READY MIX PVT
235	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
236	Testing of compressive strength of concrete cubes supplied by the Team leader, Central

	Zone, WAPCOS Limited.
237	Testing of compressive strength of SOLID BLOCKS supplied by the Team leader, Central Zone, WAPCOS Limited.
238	Testing of compressive strength of SOLID BLOCKS supplied by the Team leader, Central Zone, WAPCOS Limited.
239	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
240	Testing of compressive strength of concrete cubes supplied by the AE, PWD Buildings, Kunnamkulam.
241	MIX DESIGN by the PROJECT ENGINEER, KIIDC
242	MIX DESIGN by the PROJECT ENGINEER, KIIDC
243	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
244	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
245	Testing of compressive strength of SOLID BLOCKS supplied by the Team leader, Central Zone, WAPCOS Limited.
246	Testing of compressive strength of SOLID BLOCKS supplied by the Team leader, Central Zone, WAPCOS Limited.
247	Testing of compressive strength of SOLID BLOCKS supplied by the Team leader, Central Zone, WAPCOS Limited.
248	Testing of compressive strength of SOLID BLOCKS supplied by the Team leader, Central Zone, WAPCOS Limited.
249	Testing of compressive strength of SOLID BLOCKS supplied by the Team leader, Central Zone, WAPCOS Limited.

250	Testing of VITRIFIED TILES supplied by the Team leader, Central Zone, WAPCOS Limited.
251	Testing of compressive strength of concrete cubes supplied by the KITCO LIMITED, KOCHI
252	Testing of Cement supplied by the KITCO LIMITED, KOCHI
253	Testing of Steel supplied by the KITCO LIMITED, KOCHI
254	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
255	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
256	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
257	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
258	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
259	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
260	Testing of compressive strength of concrete cubes supplied by the TDLC
261	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
262	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
263	Testing of compressive strength of SOLID BLOCKS supplied by the Team leader, Central Zone, WAPCOS Limited.

264	Testing of compressive strength of SOLID BLOCKS supplied by the Team leader, Central Zone, WAPCOS Limited.
265	Testing of compressive strength of SOLID BLOCKS supplied by the Team leader, Central Zone, WAPCOS Limited.
266	Testing of compressive strength of SOLID BLOCKS supplied by the Team leader, Central Zone, WAPCOS Limited.
267	MIX DESIGN for Assistant Engineer, Minor Irrigation, Kodakara
267A	Testing of compressive strength of concrete cubes supplied by the KSHB, THRISSUR
268	Testing of Abrasion of paving Tiles By Capital Pavings, Shornur.
269	Testing of compressive strength of concrete cubes supplied by the BHAVA Constructions, Kochi.
270	Testing of compressive strength of concrete cubes supplied by the KITCO LIMITED, KOCHI
271	Testing of compressive strength of concrete cubes supplied by the KITCO LIMITED, KOCHI
272	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
273	Testing of compressive strength of concrete cubes supplied by the JIS JIMMY, QC INCHARGE, CEECON READY MIX
274	Testing of compressive strength of concrete cubes supplied by the BHAVA Constructions, Kochi.
275	Testing of Steel structures supplied by the AE, KSHB, TSR
276	Testing of Epoxy works supplied by the AE, KSHB, TSR
277	Testing of compressive strength of concrete cubes supplied by the TDLC, Banana & Honey Park.

278	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
279	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
280	Testing of compressive strength of ROCK core samples supplied by the Executive Engineer, ATTAPADY
281	Testing of compressive strength of concrete cubes supplied by the TDLC, Banana & Honey Park.
282	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited-FINS ENGINEERS
283	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited-FINS ENGINEERS
284	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited-FINS ENGINEERS
285	Testing of compressive strength of ROCK core samples supplied by the Assistant Executive Engineer, MI PALAKKAD
286	Testing of compressive strength of concrete cubes supplied by the Team leader, Central Zone, WAPCOS Limited.
287	Testing of compressive strength of SOLID BLOCKS supplied by the Team leader, Central Zone, WAPCOS Limited.
288	Testing of compressive strength of SOLID BLOCKS supplied by the Team leader, Central Zone, WAPCOS Limited.
289	Testing of compressive strength of SOLID BLOCKS supplied by the Team leader, Central Zone, WAPCOS Limited.
290	Testing of compressive strength of SOLID BLOCKS supplied by the Team leader, Central Zone, WAPCOS Limited.

291	Testing of structural steel samples supplied by the Team leader, Central Zone, WAPCOS Limited.
292	Testing of structural Aluminum samples supplied by the Assistant Engineer, KSHB, Thrissur
293	Testing of XYPEX Mega Mix samples supplied by the Assistant Executive Engineer, KSEB.

Appendix – IV

List of tests conducted in the SM Laboratory

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

E.7.1 Soil investigation of various works of Irrigation department-Construction of river regulator in the downstream of the Enamakkal regulator at Kolumad.

E.7.2 Project No.288 Soil investigation of Community Hall construction – Pananchery Panchayath.

E.7.3 WRD- Chitturpuzha Project- Enhancement of storage capacity-Soil investigation of works for enhancing storage capacity of KunnampiradiEri.

E.7.4 Construction of I.M Vijayan Indoor stadium and sports complex at Laloor,Thrissur.

E.7.5 Construction of bay extension roadworks(WBM)at 400/220KV substationKozhikode-Testing of construction material (1395).

E.7.6 Construction of bay extension roadworks(WBM)at 400/220KV substation Kozhikode-Testing of construction material (1394).

E.7.7 Construction of bay extension roadworks(WBM)at 400/220KV substation Kozhikode-Testing of construction material (1393).

E.7.8 Construction of bay extension roadworks(WBM)at 400/220KV substation Kozhikode - Testing of construction material (1396).

E.7.9 Soil investigation of lower Chattamunnar dam in Thalayar scheme.

E.7.10 WRD- Chitturpuzha Project-Enhancement of storage capacity of KambalatharaEri.

E.7.11. WRD - Chitturpuzha Project- Enhancement of storage capacity of VenkalakayamEri.

E.7.12 Soil investigation- Thottapilly spillway and Leading channel.

E.7.13 AVIP site investigation and DPR preparation - soil testing for checking the the feasibility of earthen dam in AVIP.

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E.7.14 Bravia property Management services- Testing of soil samples.

E.7.15 Sedimentation study of Velliyamkallu RCB using IBS & sub bottom profiler-Testing of soil samples.

E.7.16 Sedimentation Study of Neyyar reservoir using IBS & Sub Bottom Profiler – Testing of soil samples.

E.7.17 Testing of soil samples -Vidya Academy of Science and Technology.

E.7.18 Sedimentation Study of Vazhani Reservoir using IBS & Sub Bottom Profiler -Testing of soil samples.

E.7.19 Soil investigation at Pookkottumanna regulator across Chaliyar river - Testing of soil samples.

E.7.20 Testing of specimen Soil Samples of Pattissery dam.

E.7.21 Testing of Soil SamplesofPuarappillikavu-Manjummel Regulator.

E.7.22 Sedimentation Study of Malampuzha Reservoir using IBS & Sub Bottom Profiler - Testing of soil samples.

E.7.23 Soil investigation -Proposed check dam across Thoothapuzha at Mundorssikkadavu in SreekrishnapuramPanchayath of Palakkad.

E.7.24 Testing of additional soil samples – Pattissery dam.

E.7.25 Disaster Management 2018-2019 - Soil samples from several rivers under MI Division Palakkad.

E.7.26 Sedimentation Study of Kanjirapuzha Reservoir using IBS & Sub Bottom Profiler - Testing of soil samples.

E.7.27 Coastal studies including model studies surveys in co-ordination with Coastal Engineering field studies Division and Other agencies-Soil sample Testing.

E.7.28 Soil Investigation - Construction of new check dam across Thoothapuzha in VilayoorGramaPanchaytinPalakkad District.

E.7.29 Soil investigation -Construction of check dam across Gayathripuzha at AnapparaChudekkadinKavasseryPanchayath in Palakkad District.

E.7.30 Soil investigation -Desilting of PoomalaDam (SDRF 2018-2019).

E.7.31. Soil investigation - App.A-Investigation work for Padinjareveed branch canal at Ch. 1110m to 1210m.

Appendix – V

Times and Places of observation

Serial No.	Month	Date of observation
1.	April	16/04/2018
2.	May	15/05/2018
3.	June	13/06/2018
4.	July	13/07/2018
5.	August	11/08/2018
6.	September	09/09/2018
7.	October	09/10/2018
8.	November	07/11/2018
9.	December	07/12/2018
10.	January	05/01/2019
11.	February	04/02/2019
12.	March	06/03/2019

Appendix-VI

Details of Simultaneous Observations

Sl.No.	Name of Station	Time and CP Nos				
		9.00 AM	10.00 AM	11.00 AM	11.45 AM	12.30 AM
1.	Vettukkad	0112	0114	0116	0114	0112
2.	Anjengo	0223	0228	0233	0228	0223
3.	Eravipuram	0317	0322	0327	0322	0317
4.	Thottappally	0597	0600	0602	0600	0597
5.	Alapuzha	0704	0707	0710	0707	0704
6.	Thanki	0926	0930	0935	0930	0926
7.	Kannamali	1025	1037	1047	1037	1025
8.	Kuzhuppilly	1140	1147	1149	1147	1140
9.	Perinjanam	1269	1274	1279	1274	1269
10.	Nattika	1323	1330	1333	1330	1323
11.	Blangad	1418	1421	1428	1421	1418
12.	Vakkad	1595	1599	1605	1599	1595
13.	Calicut	1830	1826	NCP	1826	1830
14.	Melody	2013	2009	2004	2009	2013
15.	Thalassey (Old CP)	Back of Bishop's House	1067	1075	1067	Back of Bishop's House
16.	Kanhangad	2608	2603	2598	2603	2608
17.	Kasargod (Old CP)	531	541	550	541	531
18.	Kannuvatheertha (Old CP)	103	111	121	111	103

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