SEVICES OFFERED BY GERI

1.0 SOIL MECHANICS AND FOUNDATION ENGINEERING

Soil Mechanics Division is fully equipped for doing all the tests on foundation soil in laboratory as well as in field.

Insitu tests like Dynamic Cone Penetration test, Static Cone Penetration test, Standard Penetration test, Plate Load test and Pile Load test can be conducted in the field. Facilities for collecting undisturbed samples are also available.

The Soil Mechanics laboratory is fully equipped to conducts all laboratory tests on samples received from borrow areas as well as from foundation of structures.

Plate Load Test

Where undisturbed sampling is not possible and/or ground is made by filled up soil insitu load test on ground is more useful to evaluate the bearing capacity. A plate load test is conducted in the field at foundation level to develop a load settlement curve. On the basis of permissible settlement of the foundation and using appropriate formula and load settlement curve, allowable load on foundation can be estimated. A truss anchored in the ground is used as a reaction system and load is used as a reaction jacks. Settlement is measured by mechanical dial gauges. However, results gained from plate load test are representative for the depth equal to twice the depth of plate only.

Triaxial shear test apparatus

This equipment is used for carrying out triaxial shear test includes data acquisition system with computer hardware and software.

The program given enables the data loggers memory to be downloaded into the computer for display,displayed in graphical format and printed eliminating manual labour.

Direct shear test apparatus

The equipment used for carrying out Direct Shear test includes computer and software and all relevant accessories. Computer and the software system convert the saved data into necessary calculations and parametric graphs. The software gives the best calculates slope(c) and intercept (QUOTE $\emptyset$ $\emptyset$) values. This instrument saves the manual labours of calculation and graphs plotting.

Auger Boring

Facilities to drill upto 8 m by hand auger is available (if ground water table is not expected) for soil investigation .

Soil Investigation Report

Soil samples from bore holes which generally supervised under GERI's representative are collected and handed over to Laboratory for Consolidation, Box shear , Tri-axial shear etc. wherever necessary SBC/ABP report is also prepared and furnished in accordance with Indian Standards.

1.1 GEOTEXTILE AND REINFORCED SOIL

Geotextile is a permeable textile natural or synthetic material used in foundation of soil, rock, earth or any other geotechnical engineering. It is specially designed to be used as constructional material in conjunction with other geotechnical materials like soil & rock. Geosynthetic / Geotextile can be used for separation, filtration, drainage, reinforcement etc for Civil Engineering purposes etc.

Testing of Geotextile is necessary for deciding its suitability for specific purpose & for quality control.

The institute has recently installed UTM-100KN Specially for Geotextile Laboratory.

It has the capacity to test the following properties of Geotextile as per ASTM.

(1) Mass per unit area.
(2) Thickness
(3) Wide width tensile strength.
(4) Puncture Resistance (Index/CBR)
(5) Trapezoid Tear Strength
(6) Grab Strength

Important Application Made

- Dharoi dam
- Medha creek

Reinforced Soil

Reinforced soil is a composite construction technique in which the strength of soil is enhanced by addition of tensile reinforcement in the form of strips, anchors, geosynthetics which involves generation of frictional force between the soil and the reinforcement. Reinforced soil possesses many noble characteristics which render it eminently suitable for construction of engineering structures.

Institute has made an excellent application of reinforced soil technique in construction of a water tank. Other applications of reinforced soil technique are retaining wall, bridge abutment, road embankments etc.

Important Applications Made

- Slope protection at Gandhar
- Command area roads
- Runway of Ahmedabad air port

Important Studies Conducted

- Creep study
- Anchor pull out study
- Improvement in bearing capacity
- Earth pressure on retaining wall
- Construction of water tank
- Model / Proto scale study on
- R. E. Retaining wall

2.0 HYDROLOGY PROJECT

Hydrology Project envisages the surface water resources assessment and monitoring in term of quantity and quality. Main objective of Hydrology Project is to develop Hydrological Information System (HIS) by creating facilities and standardized procedures for Data collection, Data compilation, Data processing and Data storage for data use in further development and future scope.

The quantity assessment and monitoring, network establishment and sampling for water quality are covered, under the activities of WRIC (Water Resources Investigation Circle) of Government of Gujarat. The surface water samples collected from network stations are sent to GERI for testing and the test results after primary validation are sent to SWDC for storage and dissemination. For the above study three laboratories are established at Gandhinagar (level -II+) Vadodara (level -II+) and Rajkot (level –II).

Hydrology Project phase-I (HP-I) was implemented during the period 1995 to 2003. wherein, Government of Gujarat has established a regular monitoring of 154 sites encompassing the entire state and all the major river basin and reservoirs of the State.

As an extension to the HP-I,HP-II was conceived to include more agencies in the Project to establish facilities for hydrology information system(HIS) and to further strengthen the HP activities by addition of 23 Nos. locations were selected in 2006, and continue the study along with 154 locations of HP-I.

Following three PDS (Purpose Driven Studies) were carried out under HP-II

- To study the trend in water quality locations identified as Hot spots.
- Study of water quality fluctuations in river Viswamitri
- Study of water quality fluctuation in river Sabarmati.

Hydrology Project-II is completed with all achievement of objectives on June 2014.

3.0 ROCK MECHANICS

Rock Mechanics Laboratory is equipped for evaluating following properties of rock samples.

Physical Properties

- Water Absorption
- Density & Porosity
- True Specific Gravity
- Slake Durability Index

Engineering Properties

- Point load strength index
- Brazilian tensile strength
- Unconfined compressive strength
- Triaxial shear strength

In addition to laboratory testing in-situ tests for evaluating following rock mass properties are conducted.

- Deformability
- Joint shear strength
- Pull-out resistance of anchors
- Foundation Pull-out Tests

Important Investigation Undertaken

Foundation Pull-out test at 400 kV Transmission Line Towers Solapur - Sangli (Maharashtra).

- Plate load test at Panchana Irrigation Scheme, Karauli (Rajasthan)
- Bearing capacity test at Ranganadi Hydro-electric Project, Yazadi, (Arunachal Pradesh)
- Anchor pull out test at Indira Sagar Project, (Madhya Pradesh)

Important Research Studies Undertaken

- Effect of asperity on shear strength of jointed rock
- Evaluation of static and dynamic elastic properties of rocks met with in Gujarat.
- Geo- mechanical model studies to understand behaviour of jointed rocks.
- Evaluating pullout capacities of the anchors installed in the stilling basin bay - 3 of SSP Gujarat.
- Effect of water on unconfined compressive strength of limestone.

4.0 CONSTRUCTION MATERIALS TESTING

Conventional Materials

Facilities of testing following conventional construction materials are available

• Cement • Lime • Fly Ash • Aggregate • Water	• Stone • Tiles • Bricks • Steel • C.C. cubes

In addition to above, facility for concrete mix design is available.

New Materials

Facilities of testing following new materials are also available.

• Curing compound • Hollow bricks • LDPE film	• Epoxy mortar • Timber

Following methods are followed for assessing quality of concrete

- Ultrasonic pulse velocity - Non destructive test
- Hammer test - Non destructive test
- Core testing - Destructive test
- Concrete Mix Design

  Facilities are available for proportioning concrete mixes as per the provisions & guidelines of IS viz., 456:2000(Reaffirmed 2005), 10262:2009 (First revision) etc. and IRC guideline section 1700 structural concrete for bridges using the basic materials used for manufacture of concrete inclusive of other supplementary material. The proportioning is carried out to achieve specified characteristics at specified age, workability of fresh concrete & durability requirements.

4.1 Non Destructive Testing Of Concrete

Facilities for conducting Non destructive test of concrete (NDT) is available for:

1) Estimating compressive strength of concrete

2) Estimating uniformity and homogeneity of concrete

3) Detection of presence or absence of cracks, voids, discontinuities

4) Quality of concrete

Instruments available at GERI are:

1) Ultrasonic Pulse Velocity Apparatus (UPVA)

2) Rebound Hammer

3) Profo Scope

Non destructive testing of concrete with ultrasonic pulse velocity is carried out as per IS 13311 (Part-I): 1992 & by rebound hammer as per IS 13311 (Part-II): 1992.

Non destructive testing measures the overall quality of concrete. Pulse velocity method is a convenient technique for investigating structural concrete. The under lying principle of assessing the quality of concrete is that comparatively higher velocities are obtained when the quality of concrete in terms of density, homogeneity & uniformity is good. In case of poor quality, lower velocities are obtained.

If the quality of concrete is assessed to be 'Excellent or good' by pulse velocity method, only then the compressive strength is assessed from the rebound hammer and this is taken as

indicative of strength of concrete in the entire cross section of the concrete member. When the quality assessed is ' Medium' the estimation of compressive strength by rebound indices is effected to the entire mass only on the basis of other collateral measurements for example strength of the concrete cubes, cement content in concrete or core testing. When the quality of concrete is doubtful, no assessment of concrete strength is made from rebound hammer

4.2 Destructive testing of Concrete

Core Test :

Core test is carried out as per IS 456:2000, IS 516:2008 & 1199-2008.

The parts from which cores are to be taken and the number required shall be as per direction of the Engineer in charge and shall be representative of the whole of concrete concerned. In no case, however shall fewer than three cores be tested.

Cores shall be prepared and tested as per IS 516:2008.

Concrete in the member represented by a core test shall be considered acceptable if the average equivalent cube strength of the cores is equal to at least 85 percent of the cube strength of the grade of concrete specified for the corresponding age & no individual core has strength less than 75 percent.

4.2 Fiber Reinforced Concrete

Facility is available for concrete mix design with fibers as reinforcing materials. The bonding between the fibers and the concrete has to be good to withstand the changing environment.

5.0 PETROGRAPHIC ANALYSIS

Engineering Geology Division deals with petrographic examination of rocks and natural aggregates.

Petrographic Examination

Megascopic and Microscopic examination of rocks, mineral constituents and their characteristics study is carried out. Petrographic analysis of coarse, crushed and fine aggregates to identify the chemically deleterious and physically poor constituents which affect the quality of concrete and mortar. To carry out above test I.S. No 2386-1963 (part -VIII) and I.S. No 383-1970 are used.

Petrological polarizing microscope and stereo microscope are the main equipments used for testing. Petrological Trinoculor polarizing microscope with micro photographic equipment and connectivity to monitor via CCD camera along with CCTV and image grabbing card including computer is used for microscopic examination of rock.

Important Studies in Petrological Laboratory :

Identification of rocks and minerals

Quality of aggregate from all major & minor rivers of Gujarat

5.1 Seismological Investigation

Seismological investigations are carried out by establishing seismological observatories located at and around major Irrigation Projects in the state. At present two projects are under progress

1) World Bank assisted DST, New Delhi's project for seismological studies in Peninsular shield region.

Under this project out of 10 seismological observatories in peninsular shield region of India, one observatory is established at Dharoi Irrigation Project in north Gujarat .The earthquakes are being recorded at Dharoi Broad Band seismological observatory and the same is being transmitted to National Geophysical Research Institute, Hyderabad through VSAT communication system.The data is further processed and analysed at GERI, Vadodara

2)Establishment and monitoring a network of Seismological Observatories around proposed Kalpasar project

A proposal, amounting Rs 9.6 crore, on the project 'Establishment and monitoring a network of Seismological Observatories around proposed Kalpasar project' is submitted to government. The project will be comprising of establishment of 8 Seismological observatories (each comprising of Broad Band Seismographs and Strong Motion Accelerographs), monitoring and study the seismicity around the project for 5 years. All the 8 observatories are planned to be connected with VSAT communication system for online data transmission to Central Data Centre at GERI, Vadodara. The seismic noise survey for finalization of quiet site for observatory buildings at various propose sites has been carried out in association with Indian Institute of Technology, Roorkee,

5.3 Engineering Geological Investigation

The unit mainly deals with Geological investigation as well as the geological execution work of various water resources schemes of Vadodara, Panchmahals and Dahod districts.

The geological investigation works include the preparation of reports, geological drawings and geological log sheets of various schemes.

In execution stage, preparation of foundation and assessment of foundation rocks and preparation of geological drawings and reports are prepared . The treatment is recommended, if required.

6.0 SEDIMENTATION OF RESERVOIRS

Release of bed load and deposition of suspended materials carried by inflow in the reservoir comprise the sedimentation process. Sedimentation is a phenomenon due to which capacity of reservoir reduces with lapse of time. This Phenomena of sedimentation mainly depends upon area, topography, rainfall, agriculture pattern and forest in catchments area. The sediment deposition has adverse effect such as reduction in storage capacity, increase in back water level, formation of shoals. For effective planning and use of stored water optimally it is necessary to find the actual rate of sedimentation and revised capacity of reservoirs. Therefore hydrographic survey (sedimentation survey) is to be carried out periodically for every reservoir.

Techniques Used For Evaluating Storage Capacity:

Following techniques are used to determine the storage capacity of reservoirs.

(A) Conventional Method:

(B) Integrated Bathymetric System (IBS)

(C) Remote Sensing Technique

Important Surveys Undertaken:

Since year 1979, sedimentation survey of 30 major & medium reservoirs (in all 71 times) of the Gujarat State and Mahi Bajaj Sagar & Tidi reservoir of Rajasthan State by using high tech equipment & DGPS

- Sedimentation survey of Indira Gandhi Main Canal (perennial canal) (Rajasthan) to determine the deposition of silt in the bed and bank of canal.
- Sedimentation survey of reservoir of Atul Project Ltd.,Valsad, Sedimentation survey of Singanpore weir on Tapi river of Surat Municipal Corporation.
- Eco sounding work of Malcom channel near Bhavnagar (Soda Ash Plant of Nirma Ltd.) and Narmada river stretch near Sinor of Flood Protection Work under Vadodara Irrigation Circle.

7.0 HYDRAULIC MODEL STUDIES

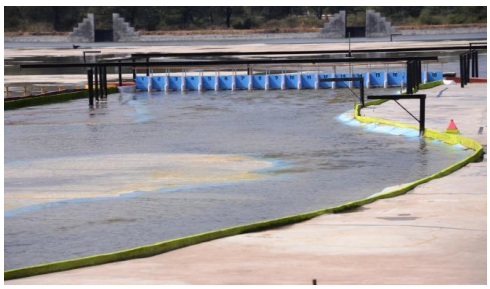
The physical model studies on scale models are been carried out at Gotri campus in Narmada Hydraulic Division GERI,Gotri Vadodara.Gotri Campus of GERI is having extensive infrastructure facilities of Hydraulic Research Studies on Physical models. The campus area about 140 acres is being utilized for constructing, running and operating the required size of scale models. About 100 physical models of various projects are existing in the campus. The

infrastructural facilities were established 35 to 40 years back includes feeder canal, return canal, HR gates, OTs, Tube wells, various flumes, channels, standing wave flumes and model trays since than these are being constantly in use. This is the only campus in Gujarat state where such type of site specific hydraulic research studies are been carried out on physical models. Some outstanding and remarkable studies were carried out at the campus in the past and accordingly GERI is known as one of the best hydraulic research station in India. At present Tapi river mega model, Bhadbhut Barrage physical model, Saradar Sarovar Dam truncated model, Sant Sarovar Barrage model , Gift City development model on Sabarmati river bank, Balloon Barrage model on Tapi river, Garudeshwar weir model are being the large enough models amongst these Tapi river model is the largest physical model in India.

At present following important studies for different projects are going on in the campus.

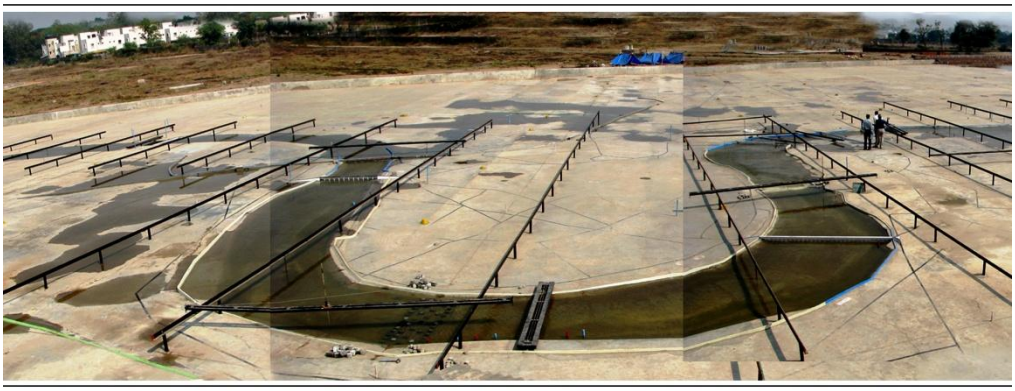
1) Bhadbhut Barrage on Narmada River, sectional (2D) model studies for capacity, scour and gate operations.

2) Bhadbhut Barrage on Narmada River, composite (3D) model studies for follow pattern, inundation and banks spell over on bank area without Barrage. Orientation of Barrage and guide bunds. Assessing effective flood protections embankment on both the banks with Barrage structure and performance of Barrage with different gate opening. This model covers 67 km River stretch from Sukaltirth to sea and 6 km sea portion for simulation of tide.



3)Tapi River model (3D)

This is the largest physical model from Ukai dam to sea for 140 km length of tail reach of Tapi River for studying the effective flood protection works on the banks to protect Surat city from flood of any magnitude



4)Balloon Barrage on Tapi River (3D) model.

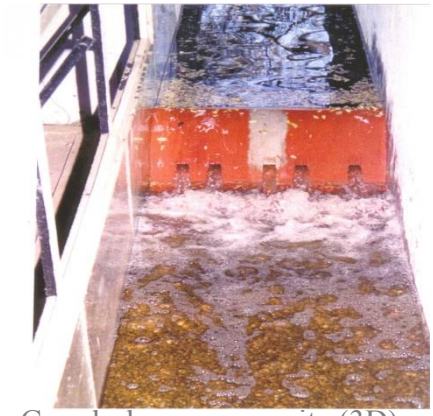
This is the first Balloon Barrage in India of 500 m length across River Tapi to create additional storage reservoir of sweet water near the sea. The studies are being carried out for effective performance and effect on flood levels due to construction of Balloon Barrage with different tide conditions.

5) Sardar Sarovar Navagam 3D model

Geometrical similar scale 1:150 mobile bed truncated spill way model is being utilized for studying upstream reservoir characteristic, down stream flow pattern, effective energy dissipation arrangements, performance of training walls and performance of auxiliary spill way.

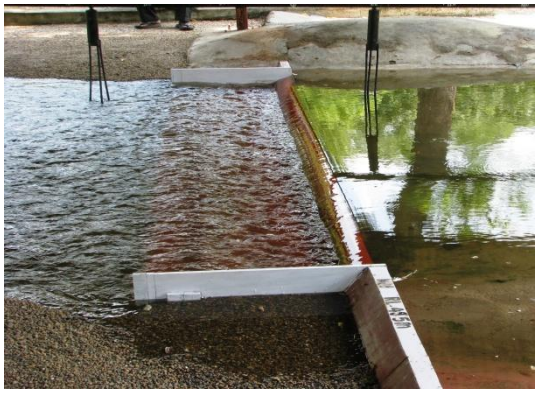
6) Garudeshwar sectional (2D) model study

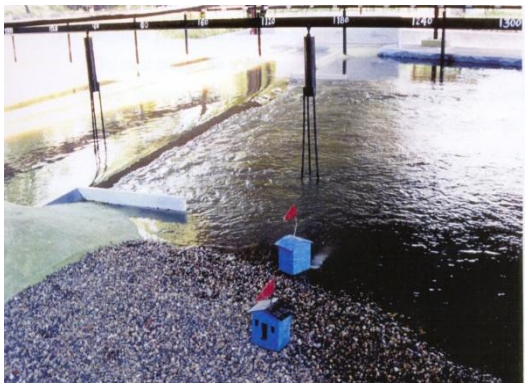
The reservoir capacity in terms of water level, effective energy dissipation arrangements and scour in the down stream of the structure are being assessed. The reservoir will be utilized for running the turbine in reversible mode of Sardar Sarovar Dam.



7) Garudeshwar composite (3D) model

Geometrical similar scale 1:150 mobile bed spill way model is being utilized for studying upstream reservoir characteristic, down stream flow pattern, effective energy dissipation arrangements, performance of training walls and sloping length of apron.



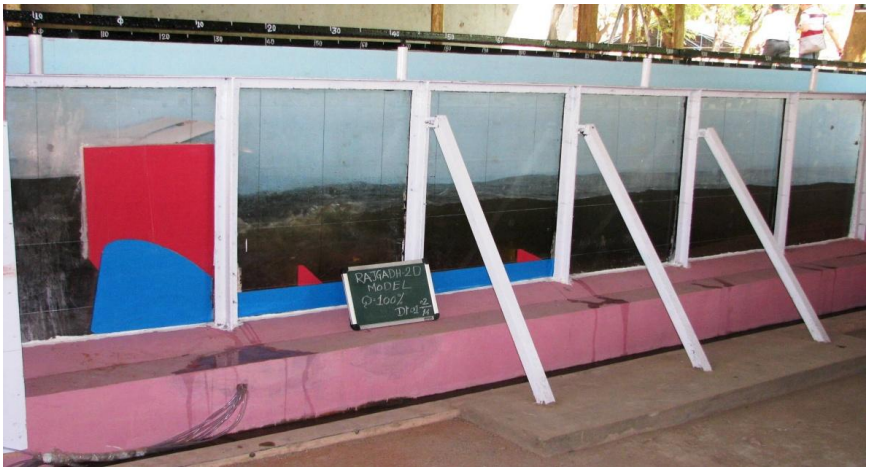


8) Nabhoi and Rinza village flood protection (3D) model

This is the part model of Sabarmati River for assessing effective flood protections work on bank of River.

9) Rajgadh (2D) model (Rajasthan)

This model being utilized for reservoir capacity in terms of water level, effective energy dissipation arrangements and scour in the down stream of the structure. The length of apron was optimized as per the flow conditions observed on the model.



10) Heran River composite (3D) model

This model is constructed to assess the flow pattern in the meander shape of River near the Narmada main canal syphon structure crossing the River. The flow was diverted using spur on left bank to protect the protection work provided on the bank.

9) Parvan Dam sectional (2D) model

This model being utilized for reservoir capacity in terms of water level, effective energy dissipation arrangements and scour in the down stream of the structure. The length of apron was optimized as per the flow conditions observed on the model

10) Parvan Dam composite (3D) model

From the model study it was suggested to trim the up stream topography in front of three gates from left side so as to achieve uniform flow on the spillway. It was also suggested to raise the height of training wall and the level of trunion axis.

11) Flood protective work on the bank of River Watrak near village Vautha

A 3D model of G.S.Scale 1: 100 was constructed to assess the inundation on the right bank and the flow velocity on the bank so as to decide the type of protection work and its orientation.

12) Ukai spillway composite (3D)model

A 3D model with G.S.scale 1:100 was utilized for assessing the performance of tail channel, combination of different gate opening and the performance of divide wall and guide bunds with and without operation of power channel for different discharges .

New hydraulic model studies are to be initiated.

(1) Aqueduct on River Orsang 3D model
(2) Sabarmati River (Gift city) 3D model
(3) Rajgadh Dam spillway 3D model (Rajasthan)
(4) Bank protection work at village Ingoli on River Sabarmati
(5) Proposed bridge on River Sabarmati near Vataman on Tarapur-Bagodara road
(6) Badalpur weir on river Mahi
(7) Bank protection work at village Kasindra on River Sabarmati
(8) Waghrech weir on River Kaveri
(9) Bank protection work of Moti Demoi on Hathmati River
(10) Physical model study of Dhatarwadi-2 dam
(11) Physical model study for Kalpsar Project

7.1 METEOROLOGICAL OBSERVATORY

The main purpose of meteorological observatory is to access the net availability of water and plan its optimum utilizations for irrigation. A model meteorological observatory is established in 1970 at Gotri campus, GERI. The main instruments installed in the observatory are as under.

(1) Rain Gauge
- Non recording
- Self Recording

(2) Thermometers
- Maximum
- Minimum
- Dry Bulb
- Wet Bulb

3) Open Pan Evaporimeter
(4) Anemometer
(5) Wind Vane
(6) Sunshine recorder
(7) Barometer

Wind - Tunnel

Accurate measurement of wind speed is very important in irrigation, shipping transport, aerodynamics etc. The instrument used for this purpose is three cup anemometer. Anemometer requires periodical calibration. For calibration purpose a wind tunnel is installed at Gotri, GERI. The tunnel having two test sections operates at maximum speed of 100 km/hr.

8.0 DAM SAFETY

There are 632 large dams in the state of which 207 are major and medium dams and 425 are minor dams. The major and medium dams are regularly inspected by DSO team once in 2-3 years whereas all minor dams are regularly inspection by DSO team once in 10 years.

The gated dams in the state, which are inspected by Civil as well as Mechanical (M) and Electrical (E) teams of DSO. During inspection an overall view of health status of each dam and its performance is rivewed. Remedial measures are suggested by Central Design Organisation where ever require.

DSO publishes report on annual health status report incorporating activities of dam safety organisation every year. It also organises workshops in different regions of the state to educate the project officers for the various requirements of dam safety aspects. It also acts as a link between CWC and owners of dams.

9.0 ROAD RESEARCH AND TRAFFIC STUDIES

There is a separate Road Research set up under GERI headed by a Joint Director (R). The activities are manifold.

Field Investigations

Facilities for following field investigations are available

- field density and field moisture content by conventional methods
- evaluating overlay thickness by Bankleman Beam Deflection method
- unevenness measurement by bump integrator unit
- measurement of cracks, ruts, depressions, pot holes etc by visual rating
- pavement performance study
- Junction Design
- Traffic Survey

Laboratory Testing

Following testing facilities are available

- Soil
- Aggregate
- Bitumen
- Emulsion
- Modified Bitumen
- Antistripping agent
- Binder content by centrifuge method
- Asphalt mix design
- Flexible pavement design
- Retro-Reflectometer for measuring the reflection property of road sign boards

Traffic Survey

- Speed flow
- Traffic count survey
- Origin-destination survey
- Traffic and transportation management study
- Road safety audit study

10.0 SOIL SURVEY

There is a separate soil survey organization under GERI headed by a Superintending Engineer (Soil, Drainage and Reclamation). There are three soil survey division headed by Soil Survey Officers working in different parts of the state.

Important Activities Undertaken

Reconnaissance soil survey in command areas of Water Resources Projects

Detailed soil survey

- Observance of X-limits
- Monitoring sub soil in command areas.
- Monitoring salinity and water logging conditions

- Special surveys

Important Activities Undertaken :-

1. The pre-irrigation reconnaissance soil survey at feasibility stage and detailed soil survey at execution stage is required to be taken up for irrigation project to make interpretation of irrigation suitability of land, based on such data cropping pattern, intensity of irrigation, sizing of canal etc. are decided. These data forms base line for future monitoring.
2. Post-irrigation soil survey are carried out after irrigation potentials are created, to monitor the change in soil properties due to effect of irrigation and to identifying the changes and problems (positive and negative impacts).
3. The Sub Soil Water Table (S.S.W.T.) observations in the command areas of various major and medium irrigation projects in the state are taken twice in a year i.e. pre-monsoon (May-June) and post-monsoon (Oct.-Nov.). open cum dug wells are allocated for observation. The S.S.W.T. is measured and samples are collected from fixed wells for the study of quality of well water in relation to irrigation purpose. These observations are continuously carried out since last more than 2 decades.

To get the details (Gujarati) about various project click on project title

- Kakarapar
- Ukai Left Bank Cana
- Ukai Right Bank Canal
- Mahi Right bank
- Fatewadi
- Dantiwada
- Sabarmati(Dharoi)
- Panam
- Bhadar- Panchmahal
- Bhadar-Rajkot
- Shetrunji